UNITED STATES AND THE IRAQI MARSHLANDS: AN ENVIRONMENTAL RESPONSE

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BEFORE THE

SUBCOMMITTEE ON THE MIDDLE EAST AND CENTRAL ASIA

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UNITED STATES AND THE IRAQI MARSHLANDS: AN ENVIRONMENTAL RESPONSE

TUESDAY, FEBRUARY 24, 2004

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON THE MIDDLE EAST
AND CENTRAL ASIA,
COMMITTEE ON INTERNATIONAL RELATIONS,
Washington, DC.

The Subcommittee met, pursuant to call, at 10:02 a.m. in Room 2172, Rayburn House Office Building, Hon. Ileana Ros-Lehtinen (Chairwoman of the Subcommittee) presiding.

Ms. ROS-LEHTINEN. The Subcommittee will come to order.

Thank you so much.

I want to thank the witnesses who will be testifying this morning and during this hearing on the ecological disasters that have taken place in southern Iraq. Thank you so much for being here, and I thank the audience members as well.

What is important to understand about this situation is that this disaster was manmade. It was the product of the corrupt, terror-ridden government of Saddam Hussein. This region, known as the "Eden of Iraq," was destroyed. Saddam's regime built dams, dikes, and canals to drain these ancient marshes to punish the Marsh Arabs for their support of the Shi'ites who rebelled against his forces immediately after the Persian Gulf War in 1991. Because they were accused of hiding rebels, deserters, and other opponents of Saddam, all Marsh Arabs were punished. Their way of life, their homes, and their very existence was pushed to the edge of extinction.

Yet, Saddam did more than evict thousands of people from their homes. He brought ecological devastation to this ancient area. These once thriving wetlands were drained by over 90 percent. Entire habitats were ruined, water quality was drastically diminished, and climate conditions were affected. Health conditions resulting from this slaughter are yet to be fully known. The economy of the region that depended on the marshlands was also ruined. Fishing in the Persian Gulf has suffered as well.

Now that Saddam Hussein and his criminal regime are part of an unhappy history, attention must turn to restoring the marshlands.

While Congress chose not to fund this important effort last year when the Administration asked for a total of $100,000,000, today we must reexamine the issue. There are several projects under way toward reconstructing the area, and I understand the USAID is

asking for $4,000,000 this year to conduct studies of the needs of this area.

Those needs are many. They include an alleviation of the soil salinity, restoration of the vegetation and habitat areas for wildlife and, if possible, a restoration of the homes for the Marsh Arabs, so many of whom remain as refugees in their own countries and neighboring ones as well.

I am interested in learning what efforts will be made to restore the refugees to their homes. I would also like to know what are the needs for the reestablishment of the wildlife that was chased from the area with the destruction of the marshlands.

Among our witnesses today, two in particular are working on projects to restore this vital area to its former condition:

Dr. Azzam Alwash is the Senior Project Adviser of the Eden Again Project, which is part of the Iraq Foundation. He has been working on various methods and strategies to restore this region, and he has brought us a letter to include in the record. I will ask that this letter from the Iraq Foundation to the Italian Minister of the Environment be made part of the record.

[The information referred to follows:]

Ministry for the Environment
And Territory
Directorate for Environmental Research and Development
Director General

IRAQ FOUNDATION
1012 14th Street . N.W. Suite 1110
Washington DC . 20005 - 3406
U.S.A.
Att. Mr Azzam ALWASH

Subject: The new Eden Project

Dear Mr Alwash.

With reference to the agreement of collaboration between the Italian Ministry for Environment and Territory and the Iraq Foundation, I wish to express the high appreciation for the work you have carried out so far. In particular we have been very satisfied with your commitment to the activities conducted in Iraq including the marshland restoration, the identification of a new pilot project to monitor the Abu Zarag Marsh and the combined use of water resources and energy dispersed in the petrol fields to desalinate water, as highlighted in the interim report approved last December.

We are also very pleased with the dissemination activities undertaken, particularly the UNEP conference at Geneva, the Marshland conference held in Miami and the forthcoming EWRA conference in Salt Lake City, as well as the presentation you will have in front of the Congress of the United States.

We are therefore delighted to confirm the wish of our Ministry to proceed with the technical and financial support to the Iraq Foundation for the coming projects, e.g. Marshland Master Plan, also in co-operation with other donors.

We will appreciate if you could also present to the Congress of the United States the activities carried out in Iraq within the framework of our agreement, on behalf of our Ministry for Environment and Territory.

With kind regards,

Dott. Corrado Clini
Ministry for the Environment and Territory

Ms. ROS-LEHTINEN. We will also hear from Dr. Fernando Miralles-Wilhelm from the University of Miami's Department of Civil, Architectural and Environmental Engineering, he is also working on a project for restoration of the marshlands.

Additionally, we will hear from Mr. Gordon West, Deputy Assistant Administrator of the United States Agency for International Development. Mr. West is responsible for all USAID programs for the Asia region.

Thank you, Mr. West.

USAID has taken a clear lead in working in restoring the marshlands. I know that your administrator has taken a particular interest in the marshlands, and we thank Andrew for that.

Also from USAID, Doctor John Wilson, the Senior Environmental Officer for USAID's Bureau for Asia and Near East, will testify.

All of our witnesses today will explain to the Subcommittee not only what needs to be done for the restoration of the marshlands but what the costs, both human and material, will be to bring this restoration to reality.

Saddam Hussein's wanton destruction of the marshlands and the lives of so many has left lasting damage to the environment and to society. His actions here were yet one more sign of a brutal dictatorship that had been left to weave its evil intent on the land of Iraq.

An area this vital to so many people spread over such a wide area needs to be brought back to life in order to erase the scars of a dictator. As our witnesses relate their findings and recommendations to the marshlands, I hope that they will further detail the extent of the destruction and particularly the human price paid for this horrific punitive act.

I look forward to hearing the testimony of our witnesses today, and we will begin with Mr. West.

Thank you. All of your statements will be made a part of the record, and you will feel free to summarize as you wish. Thank you.

Mr. West.

STATEMENT OF GORDON WEST, ACTING ASSISTANT ADMINISTRATOR, BUREAU FOR ASIA AND THE NEAR EAST, U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT

Mr. WEST. Chairman Ros-Lehtinen, distinguished experts and guests, I thank you very much for this opportunity to present to the Subcommittee on behalf of USAID concerning work in the Iraqi marshlands.

First, just for clarification on the record, although I do oversee Asia, for the last year my primary responsibilities have been directly overseeing all work in Iraq. So that has been my overwhelming task for the past months.

I must say I am not an environmentalist, so I am going to leave the details and the specifics on the scientific end to Dr. Wilson and other experts today.

To echo your statement, our Administrator, Mr. Natsios, is passionately concerned of the status of the Marsh Arabs and the marshlands themselves as represented by the pictures all over his office walls.

I, too, in a general sense, although not knowing the specifics of the environmental side, have followed closely the concerns and the initiatives that have been undertaken over the past year.

I would note that many of the factors that impact on the marshland areas are really external to itself—in other words, they are captive to many upstream actions which, in his case, were vicious in nature in cutting people off from the source of their livelihood, also work in the opposite trend.

Currently, there are several billions of dollars invested in the area of water, irrigation, wastewater management. For instance, the health impact of the pollution of the water of the Tigris and Euphrates is having a tremendous impact on the health of the peoples of the marshlands.

One of the primary causes of that is the fact that raw sewage from Baghdad is put into the rivers. That is a major challenge to clean up the waters of the rivers, and that really starts with Baghdad, where a large percentage of the population lies. We are hoping that by this summer most of the large-scale, direct dumpage of sewage will be curtailed and that new facilities will be online for the majority of the population of Baghdad.

Similarly, other types of ongoing activities, many of which, unfortunately, we do not read about very often in the papers, are ongoing at the local government level, involving health, involving education, the development of local government structures, civil action programs that involve communities in the resolution of their own problems. We are very encouraged by the cooperation among military, USAID, communities, local governments, and the people themselves, to resolve problems at the local level.

That said, there are very specific factors that are internal to the marshlands. They were very well highlighted, the challenges we face, in an article in *The New York Times*, the other day, very interesting. It does highlight the complexity of the issues involved.

To begin addressing these issues, USAID has already committed $4 million—they were really taken from fiscal year 2003 funding—to begin an environmental study on the problems in the marshlands.

We are doing that in cooperation with the State Department OES Bureau, and we are initiating an international effort to examine and find common solutions to some of the issues in the marshlands.

Some of the areas that we have focused on, first, is analyzing the extent of damage to the marshlands areas. Up to recently we really were only able to get satellite and remote sensing photography to analyze the issues. We have had teams that have been going in now, that are able to take water, soil samples and other scientific studies to begin to examine on the ground the exact extent of the damage.

A lot of what we have been able to do is to also establish relations with the people themselves, to understand what they have been through.

We have been able to reinitiate contact with the scientific community. This includes institutions like the University of Basra and many other of the local institutions and the government them-

selves, the various ministries who have oversight in this multi-sectorial area.

Beyond that, we also have been able to lead the development of a framework for international cooperation. In addition to United States interests, we note that Canada, Italy, Australia and Japan, to mention a few, have already stepped up and are very interested in becoming actively involved in trying to find solutions and provide resources toward the problems faced in the marshlands.

I would like to now turn to Dr. Wilson for a more detailed examination of both findings of our initial research and the best means for helping to restore the marshlands, Doctor John Wilson.

Thank you so much, Ms. Chairman.

Ms. ROS-LEHTINEN. Thank you so much, Mr. West.

Dr. Wilson.

STATEMENT OF JOHN WILSON, SENIOR ENVIRONMENTAL OFFICER, BUREAU FOR ASIA AND THE NEAR EAST, U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT

Mr. WILSON. Chairman Ros-Lehtinen, distinguished members of the audience, I appreciate this opportunity to discuss and testify before the Subcommittee on USAID's efforts to restore the Iraqi marshlands.

The Mesopotamia marshlands once comprised more than 20,000 square kilometers of interconnected lakes, mudflats, and wetlands. These marshes were spread over an area twice the size of the Everglades, and they served as home for the Marsh Arabs for the past 5,000 years.

As we just heard from you and Gordon West, over the course of the past decade the regime of Saddam Hussein systematically and maliciously drained and destroyed these globally important wetlands. By 1999, the drainage of the marshlands was largely over. The only marshland left of any note was the northern port of the al Hawizeh marsh, which straddled the Iraq-Iran border.

By the beginning of 2003, just 7 percent of the marshland remained. The marshlands had been dispersed and decimated. An area once known for its cultural richness and biodiversity had largely been destroyed.

Although the situation is dire, there are signs of hope. There has been recent reflooding throughout the marshlands. This reflooding is due to a combination of heavier than normal snowfalls in the North, the deliberate destruction of structures by the people in the area, the opening of gates by the Ministry of Water Resources, and the release of water by Iran to the east. Recent imagery from NASA shows that what was once 7 percent of the remaining wetlands is now 30 percent, so there are signs of hope.

The dynamic scale and complexity of any effort to assist the Marsh Arabs and rehabilitate the marshlands will require an international partnership of donors, humanitarian groups, technical experts and direct stakeholders working toward a common vision of what is both desirable, realistically achievable and sustainable.

The U.S. Agency for International Development and the State Department, in close collaboration with the Coalition Provisional Authority and the Iraq Ministry of Water Resources, are leading an interagency effort to develop this vision and framework for action.

Indeed, this effort is intended to foster and support the growing international effort for the restoration of the Iraqi marshlands and the livelihood of the Marsh Arabs who reside in and around them.

The rehabilitation of Iraq's marshlands has been treated by some as a largely technical problem that can be dealt with through specialized expertise. USAID's perspective is that restoration of Iraq's marshlands will require a complicated multi-party collaboration that brings stakeholders such as the Marsh Arabs together to express their own goals in order to move toward reaching shared goals and strategies.

It is already apparent, as that *New York Times* article mentioned, that what seemed like a simple matter of reflooding the marshes has turned into an endeavor as tangled as the aquatic plants taking root there. Some of the Marsh Arabs look forward to reflooding depending on fishing and water buffalo. Others do not, preferring to pursue dry lands agriculture.

To set the stage for this complex wetlands rehabilitation effort, USAID supported a rapid assessment of the marshlands last June. For the most part, the team returned with promising initial findings.

After visiting existing flooded and drained marshes, early concerns due to elevated soil salinity levels seemed less serious than originally anticipated. The water levels also showed lower salinities. In addition, the team established relations at local institutions, such as staff from both district and national level of Ministry of Water resources and the University of Basra, who will be key counterparts for the marshland restoration effort.

Any program dealing with the management and rehabilitation of the Iraqi marshland will need to address the increasing competition for water. While they have undergone drastic and irreversible change, other areas upstream have been undergoing transformation. The situation is compounded by dam building. By 2001, 32 dams were already built on the Tigris and Euphrates Rivers, with another 21 planned or under construction, including on the Karke River in Iran.

These findings and constraints, including the availability of water, are being incorporated into the design of the marshland restoration program which will proceed along two tracks. At the national level, the Ministry of Water Resources is receiving assistance with hydrological modeling and strategic planning. Serious planning must be grounded on an understanding of water availability within the basin.

Development of hydrological models for the entire basin is already under way by the U.S. Army Corps of Engineers and by the Ministry of Water Resources, and the results of this modeling will be used in conjunction with strategic planning by the Ministry of Water Resources to inform water resources management decision-making at national and local levels.

At the local level, the marshlands restoration program seeks to extend social and economic assistance to the marsh dwellers, introducing in quick order carefully targeted interventions to improve the livelihood of the Marsh Arabs and others residing around the marshes.

Key areas of opportunity currently being investigated include rehabilitation of date palm orchards, looking at livestock support, and fisheries reclamation. We are also looking at ways to address the chronic health needs in the marshlands where the lack of clean drinking water in the area is a problem.

The field of marshland restoration is unfamiliar to Iraq's educational and scientific communities. Environmental science is also poorly understood. An essential challenge to the marshland restoration program is to change the previous record of destruction to a spring boom for environmental protection and rejuvenation.

Given limited resources, USAID's marshland program will not be able to undertake ambitious, long-term institution-building, but rather we will focus on providing targeted opportunities for Iraqis in government, universities, and in research centers to learn about and adopt marshland management approaches through short courses, international study tours, and complementary laboratory work. For example, we are proceeding with a study of the Everglades to better understand wetland management. A scoping team is currently in Basra conducting data collection, identifying sites for restoration activities, and identifying intervention for economic assistance.

How much of the original marshland can be restored remains to be determined. Water availability will be a limiting factor, and it is unlikely the marshlands can ever be restored to their full glory. Nevertheless, restoration of the marshlands deserves a high priority in the reconstruction efforts in Iraq due to their importance to the economy, security, and ecology of the region.

I look forward to the successful implementation of the marshland restoration program. Thank you.

Ms. ROS-LEHTINEN. Thank you so much.

[The prepared statement of Mr. West and Mr. Wilson follows:]

PREPARED STATEMENT OF GORDON WEST, ACTING ASSISTANT ADMINISTRATOR, AND JOHN WILSON, SENIOR ENVIRONMENTAL OFFICER, BUREAU FOR ASIA AND THE NEAR EAST, U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT

Summary: In the highly dynamic, post-war situation, the U.S. Agency for International Development is leading an interagency effort with the U.S. State Department's Bureau for Oceans and International Environmental and Scientific Affairs (OES) to develop an action plan for marshland restoration. The $4 million program intends to integrate economic development and ecosystem marsh management, implement restoration and social economic assistance programs, collect and monitor data for reflooded sites, and develop capacity in Iraqi government and universities in marshland management and restoration.

From June 15–28, 2003, USAID project staff met with marsh dwellers to assess social and economic conditions. The team visited a wide range of tribesmen and women throughout the marshes from the traditional floating islands populations to rice growers living on the periphery. They extensively visited the existing, reflooded, and drained marshes on the ground and in helicopter flyovers. Foreign and Iraqi experts have collected soil and water samples from the natural and reflooded marshes. All of the USAID-financed activities have involved scientists from the University of Basra and established working relationships with national and district level Ministry of Water Resources officers.

Preliminary conclusions on the status of the marshes note that some portions of Hawizeh and Hammar marsh still retain native vegetation and good water quality. Some of the formerly drained wetlands have recently been reflooded. These regions may be a seed source and faunal population base for restoring the drained marshes. By contrast, Central marsh has suffered massive drainage, and little wetland remains. Vast areas of former marsh are now barren or are sparsely covered with

Tamarix and other desert species. Dust storms are now prevalent in the former marsh areas.

The next steps in the marsh assistance program include more on-the-ground investigation and discussions with Iraqi officials to understand the drainage system and develop a precise inventory of all structures. People in the marshes want clean drinking water, mosquito control, jobs, health care, and improved security. Marsh-based activities alone will probably not provide an adequate economic base. The previous regime's aggressive policies draining the marshes and promoting unsustainable wheat-growing as a monoculture undermined the region's economic base.

I. INTRODUCTION

Historical Background: The Iraqi Marshlands

In little more than a decade, Saddam Hussein's regime systematically destroyed one of the world's largest wetlands ecosystems. This environmental disaster, perpetrated in the roughly 20,000 square kilometer marshlands of southern Iraq, an area more than twice the size of the Florida Everglades, has been compared in scale to the drying up of the Aral Sea in Central Asia and the deforestation of the Amazon. The area was once famous for its cultural richness and biodiversity. The marshes were the permanent habitat for millions of birds and a flyway for billions more migrating between Siberia and Africa. Sixty-six bird species may now be at risk. Other populations are thought to be in serious decline. Coastal fisheries in the Persian Gulf used the marshlands for spawning migrations, and they served as nursery grounds for shrimp and fish. Now fish catches have been significantly decreased. The marshlands also once served as a natural filter for waste and other pollutants in the Tigris and Euphrates rivers, protecting the gulf which has now become noticeably degraded along the coast of Kuwait.

The indigenous marsh dwellers already have a special place in the anthropological and travel literature for their alluring way of life, living in harmony with the environment on manmade reed islands and along the periphery of the marshes in relative isolation. They may have numbered a half a million in the 1950s and a quarter of a million in the early 1990s. In 1991, a populist Shi'a uprising at the end of the Gulf War brought down the full and brutal weight of the Baghdad regime. The military raided settlements, killed tens of thousands of Marsh Arabs—although the actual number may be higher, burned settlements, and killed livestock, destroying the core of the local economy.

The period from 1991 to 1997 was marked by engineering programs which drained the marshes through the construction of manmade rivers and canals of massive proportions and overblown names. They diverted water from the marshes to irrigate vast areas for uneconomical and unsustainable wheat production, fill huge depressions or ponds to evaporate, or drain into the Shatt Al Arab. A disproportionate share of the country's limited resources was channeled into these works. By 1999, the draining of the marshes was largely over. The only remaining marsh of any note was the northern portion of Hawizeh which straddles the Iran-Iraq border. The other two marshes, Hammar and Central to the west, were totally desiccated.

At the beginning of 2003, only seven percent of the original marshlands remained. However, there has been some recent reflooding throughout the marshes. This water appears to be from a combination of heavier than usual snows in the north, the deliberate destruction of structures by people in the area after the war, the opening of gates by local government officers, and the release of water by Iran to the east.

Marsh Dwellers: Identity, Settlement and Rights

As recently as the 1970s, there was a limited government presence in the marshlands. The Iran-Iraq War of the 1980s brought the Saddam Hussein regime in full military strength, and the displacement of tribes closest to the border began. Marsh dwellers were moved from Hawizeh in 1984 so that a dike for gun emplacements and a large army base could be built. The dike effectively drained large areas of the marsh and started the people on a series of forced moves over the succeeding 15 years. It was also the most sustained contact with the government to date. The marsh dwellers were said to have strongly supported the Iraq government during that war. The situation became more unstable with the Gulf War, and there are reports that both marsh dwellers and outsiders escaped into the marshes for refuge, this time earning the wrath of the Iraqi army.

Following the Gulf War in February 1991, the Shi'a population rebelled against the regime after active outside encouragement, apparently taking control of most of the South. In March, the government brought in tanks and helicopters and regained control through the brutal killing of 100,000 or more people and the wholesale destruction of cities and towns. The drainage of the marshes was then put into high

gear, becoming one of the highest government priorities, despite the huge investment required. The period also marked an expanded effort to force the marsh dwellers into internal displacement or foreign exile. Roughly 100,000 southern Iraqis are in border refugee camps in Iran; an uncertain number are in Saudi Arabia. No one is certain how many marsh dwellers live within the former or still existing marshlands, but estimates suggest 100,000 to 150,000 other marsh dwellers have moved farther outside the area, usually to the cities in the South.

Given the social upheaval during the past 20 years, intensifying over the last 12, the team was particularly interested in better understanding the extent to which this treatment was uniform across the marshes, the degree of displacement and social disorder, and strategies for economic assistance in such a war-torn environment.

Diversity within the Marsh Dweller Population

Marsh Arabs are members of nine major indigenous tribes and live within and on the margins of the marshes. Initial findings of a USAID-funded demographic census and public health survey, indicate that there are roughly 85,000 people who are Marsh dwellers still living in or residing on the margins of the marshes. This number is roughly double what people generally have believed to still be in the area and a third of population 20 years ago. In addition to the Marsh Arabs there are peripheral dwellers, not members of those nine tribes, who utilize the marshes directly or indirectly.

There are five major patterns of settlement and economic use of the marshes for those who are living in marsh, on its periphery, or were forced into internal or external exile. These differences have important implications for deciding who are to be the beneficiaries of the marshlands program.

1. *Marsh Arabs living inside the marshes in traditional patterns, having a long history of living on small, isolated islands.*

   There are marsh dwellers still residing in the interior of Hammar marsh in small communities. This is an area written about the earlier travelers' accounts. The one settlement visited, named Al bu Ajaj in Al Chibayish, was first displaced in 1991 and moved as a group eight times in nine years, only to be brought back by the army to within a kilometer of where they began. They spoke of burned houses and killed livestock. They now live in both reed and unbaked mud brick houses and have boats for fishing, water buffalo for a major part of their diet, and minor agricultural productivity. These people are suffering from malnutrition and water-borne diseases and drinking untreated and unfiltered water directly out of the marsh. They have neither schools nor primary health care.

2. *Marsh Arabs who had lived in the marshes but were displaced to drained areas on the margin of the present marshes.*

   Displaced dwellers were moved between six and sixteen times during a nine year period. Among the early displaced people were the dwellers in Turaba in Hawizeh marsh on the Iran border, who were relocated in 1984 when the army built a dike and large base on their village site. Many more were displaced in 1991after the Shi'a uprising.

3. *People living stably on the edge of newly reflooded marshes with a mixed economy.*

   Villages of people who have historically lived in cement-surfaced brick houses now reside along the periphery of Hammar marsh. These people were never displaced during the Saddam Hussein regime. They practiced a mixed economy, working in agriculture with palm trees intercropped with other crops, growing wheat, and tending sheep and goats. They also exploited the marshes with boats: fishing, birding, and collecting reeds. Those activities ceased with the drainage of the marsh in 1991, but the population quickly returned to marsh activities in mid-April with the reflooding.

4. *People living stably on the margin of the newly reflooded marshes who previously did not use the marsh as part of their economy.*

   Villages which were equally stable historically, its residents not having been displaced during the years of drainage, also reside along the western periphery of Hammar marsh. Here, the people grew palms, intercropped with winter wheat and summer rice. This season is the first time in 12 years that they have been able to grow rice, a good income earner, because of the reflooding of Hammar. These people have never exploited the marshes, except by drawing its water for field crops. They do not fish, hunt, have boats, collect reeds, or make mats.

5. *Former marsh dwellers who were internally displaced and live in the towns and cities not working in agriculture or marsh-related occupations.*

A number of sub-tribes and individual marsh dwellers voluntarily left the marshes for cities and towns in the south. Others are said to be in Najaf and Baghdad or might have moved to the north as part of an Arabization of the Kurdish north. We do not know how many are in this category. People we met in Basra had moved from Hammar marsh in 1991. Many were working in occupations removed from the marshes, with the apparent exception of a sheikh who was a prominent importer of nylon nets from Thailand, which are widely used in the marshes by fisherman. They would consider returning to the marshes, where they spoke of large landholdings with orchards of date palms, but they demanded compensation for past mistreatment, new seed varieties, and a reliable water supply.

Public Health Conditions and Concerns

People in the marshlands suffer from an absence of primary health care, malnutrition, and contaminated drinking water. There are no government services. Schistosomiasis, worms, and cholera are prevalent. Clean drinking water is a problem throughout the area. Some people purchase tanker water, having some access to treated water, but those within the marshes drink directly from the untreated source. Drinking water quality was consistently mentioned by people as their first priority. Mosquitoes, which plagued people throughout the marshes, are the second priority heard from the marsh dwellers. The mosquito problem may have been worsened by the reflooding of the marshes which do not have adequate fish in number to eat the larvae.

Economic Assistance: Local Economy and Opportunities

The marshlands witnessed massive government investment over the past two decades to first drain the area and second develop an irrigation infrastructure for the cultivation of wheat. But there has been no investment to improve the lives of the local population for decades. All government policies and actions were directed toward making the people more subservient to and dependent upon the ruling clique. As a result, there is little economic opportunity within the marshes and on their periphery. The large numbers of displaced people were almost wholly dependent on monthly food allocations. Even those people who were not displaced and depended on wheat growing sold their harvests at a crippling loss to the government. The traditional economic pursuits, including commercial fishing and birding, were brought to a standstill. Mat-making continued in the larger towns of Al Chibayish and Hammar City, but was severely undermined by the drying of the marshes.

Today, economic activity in the marshlands revolves around subsistence and limited market wheat-growing. Agricultural activity in the region is largely a monoculture, although there are a few pockets date palm orchards and vegetables grown on the river banks.

Marshlands Status: Vegetation, Soil and Water

Water and soil samples were taken along with field measurements at 36 sites for salinity, conductivity, pH, water temperature, total dissolved solids, and redox and oxygen to assess the ecological and biogeochemical status of marshes that had remained flooded, were recently flooded, or were totally drained and dried out since the early 1990s. Samples were also taken at selected locations along the Tigris and Euphrates rivers, the Shatt al Arab, and selected canals, in order to determine current water quality conditions as well as assess the nutrient and chemical status of waters that are flowing to either the Persian Gulf or in some cases into the marshes. In addition, drinking water samples were taken at selected locations including in the marsh Arab villages to determine the quality of water that people were drinking. The detailed results of the soil and water samples are available and will be published soon.

Water Resources: Drainage Structures and Flow Data

During the past twenty years, much of what was known about the drainage structures came from analyses of remote sensing photographs. The previously inaccessible area has been the battleground for three major wars and for a massive drainage effort which the Saddam Hussein regime characterized as the physical infrastructure for an irrigation network. The USAID scoping team made the first on-the-ground assessment of this massive drainage system to date.

PRELIMINARY CONCLUSIONS

Based on the historical background and recent research conducted regarding the marshlands and the local residents, USAID has reached the following preliminary conclusions. These conclusions inform the Agency's program objectives and approach.

- After twenty years of almost continuous wars, sanctions, and persecution of the local people, the area is bereft of a stable economy and desirable employment opportunities. Marsh-based activities will probably not provide an adequate economic base to this savaged area.
- Despite their ethnic homogeneity, there are a number of distinct patterns of economic utilization of the marsh dwellers, both voluntary and involuntary. The most surprising pattern is by those living on the periphery: some practiced a mixed economy of agriculture and marsh use, while others only practiced agriculture, despite their physical proximity. With the reflooding of areas of the marshes, people often moved quickly to re-exploit the areas, taking up boating, fishing, and reed harvesting where sufficient reeds were available.
- Although there has been considerable physical and social upheaval during the past twenty years in the marshes, there is also a remarkable degree of social continuity, given that tribes or sub-tribes usually moved as a group from location to location by the government. The key role of tribal elders has remained largely intact.
- People in the marshes are requesting clean drinking water, mosquito control, employment opportunities, health care, and improved security. Many internally displaced people and external refugees are expected to return to the marshes in the coming months and years. They ask for social services that have never been accessible to them in the past but ought to be expected of any representative civil society in the future.
- More on-the-ground investigation and discussions with the Ministry of Water Resources district offices are needed to understand the drainage system and develop a precise inventory of all structures.
- Some portions of Hawizeh and Hammar marsh still retain native vegetation and good water quality. These regions may be a seed source and faunal population base for restoring the drained marshes. By contrast, Central marsh has suffered massive drainage, and little wetland remains.
- Vast areas of former marsh are now barren or are sparsely covered with Tamarix and other desert species. Dust storms are now prevalent in the former marsh areas. Larger than expected quantities of water were present in southern Iraq, and some of the formerly drained wetlands have recently been reflooded

II. USAID PROGRAM OBJECTIVES

In response to the human and ecological conditions described above, USAID, in concert with international and local Iraqi stakeholders, has developed the following objectives for its 12-month program.

- To construct an accurate environmental, social, and economic baseline of the remaining and former marshlands to plan interventions and measure their success;
- To assist with the repatriation and resettlement of marshland dwellers in the region, who will require viable economic opportunities and social institutions that are fair and equitable and give them a voice;
- To improve the management of existing marshlands and explore options to restore adjacent drained marshes; and
- To develop and reach a broad consensus on a long-term comprehensive wetland restoration strategy integrated with a regional social and economic development program.

Elements of the Program Approach

The major elements of the program's approach are to:

Integrate economic development and ecosystem marsh management;

Implement restoration and social economic assistance programs through priority pilot projects;

Collect and monitor data for reflooded sites; and

Develop local capacity in government and universities in marshland management and restoration.

U.S. Agency and International Donor Participation

In the highly dynamic, post-war situation, the U.S. Agency for International Development is leading an interagency effort with the U.S. State Department's Bureau for Oceans and International Environmental and Scientific Affairs (OES) to develop an action plan for marshland restoration. USAID and State/OES work closely with other government entities through the Interagency Marshlands Subgroup, the first of many anticipated special task forces addressing major environmental issues in Iraq. The subgroup includes representatives from the State Department, Army Corps of Engineers, U.S. Geological Survey, Environmental Protection Agency, Fish and Wildlife Service, and other agencies.

The subgroup meets regularly to explore technical issues, review donor participation, and monitor progress. It is an aim of the U.S. government to internationalize the program, recognizing that the program's ultimate success depends on both Iraqi and international participation and consensus. Thus far, the following bilateral donors have expressed an interest in supporting or directly participating in the program:

- Great Britain—supplied a technical expert on the second field trip to the marshlands;
- Australia—provide technical experts on marshlands and agricultural soil salinity problems and develop desalination strategies through the Commonwealth Scientific and Industrial Research Organization (CSIRO), a recognized leader in the field;
- Canada—will provide technical expertise in biological monitoring and wildlife conservation to the second field visit and work in partnership in program design as the lead into a larger funded program; and
- Italy—fund modeling, water budgeting, and environmental assessments through the Iraq Foundation for a long-term program design.
- Japan—has expressed interest in providing equipment and funding rural infrastructure in the marshes

On the multilateral side, we have engaged the Secretariat of the Ramsar Convention on Wetlands, which draws upon a roster of internationally recognized experts in wetlands and marshlands for technical support. United Nations and other international agencies that have shown an interest in becoming involved in as yet to be determined roles include: the World Health Organization, the United Nations Environmental Programme (UNEP), and the International Organization for Migration (IOM). The World Conservation Union (IUCN) has also expressed an interest in participating, particularly in working on water flow issues with other countries in the region.

Accomplishments of USAID Program

Implementation of USAID's marshland restoration and management program was initiated with the fielding of a small technical team to conduct a rapid assessment of the current situation in the marshlands from June 15–28, 2003. This visit to the marshlands in southern Iraq was the first on-the-ground scientific assessment in two decades. Their goals were to begin data collection to develop an action plan for the program.

Despite the security and communications concerns, the team's work exceeded expectations. There was virtually no scientific database covering the past 30 years in the marshes. The few studies during the previous regime were politically motivated to give credence to the repressive actions. No social or economic information appear to exist for half a century. During the scoping trip, the team:

- *Extensively visited the existing, reflooded, and drained marshes on the ground and in helicopter flyovers*. This scoping team was the first scientific/development effort in the Iraq marshlands for at least two decades and the first to begin the systematic canvassing of the region. Previously, all information about the draining of the marshes and its impact was gleaned through remote sensing photography, never on the ground and analyzed from a distance. The team found several areas of healthy regrowth of reeds and other freshwater vegetation and wildlife, and others with serious salinity and only salt plants. Early concerns about endangered seed banks because of highly saline water and soils may be less serious than anticipated, but further investigation is required.

- *Collected soil and water samples from the natural and reflooded marshes.* The team collected approximately 60 marsh and drinking water and 20 soil samples in the three marshes in existing and reflooded sites and in the drained marshes. The samples are being analyzed for a full range of parameters, including salinity, toxicity, pesticides, heavy metals, and water vector diseases. The team also did immediate data analyses on salinity, conductivity, total dissolved solids, dissolved oxygen, and pH. An interesting finding was that salinity was far lower than had been anticipated. The salinity of most of the water was 1.0 part per thousand (PPT) or less, rather than the 3.0–5.0 ppt expected. This level will support new freshwater plant growth. However, one site was 17.5 ppt, half of seawater, in a reflooded area of high soil salinity, with virtually no vegetative growth and no flowing water.
- *Met with marsh dwellers to assess social and economic conditions.* The team visited a wide range of tribesmen and women throughout the marshes from the traditional floating islands populations to rice growers living on the periphery. Many told horrific stories of repeated displacement, persecution, and destruction, eking out a minimal existence on wheat-growing and government handouts of basic foodstuffs. Others lived stably on the edges of the marshes, even during the entire time they were drained. Some never exploited the marshes directly, despite their proximity. Others had a mixed economy, and returned to the marshes, using boats for fishing and reed collecting when the waters returned two months ago. Initial conversations reveal diverse economic niches of the marsh dwellers. In general, they suffer from an absence of public heath services and lack clean drinking water. Many are drinking untreated water directly out of the marshes. Both illness and malnutrition are endemic.
- *Involved scientists from the University of Basra.* The previous regime systematically destroyed an independent, intellectual community in the country. The research centers and universities acted as Baathist havens. The College of Agriculture and the Marine Science Center are now shells of the well-known, highly regarded institutions they were once. Staff have been isolated from new developments in their fields for the past 20 years and lack any knowledge of environmental science and wetlands ecology, but they are well trained in their narrow technical fields. They are eager to participate in the program, which can offer training and research opportunities. The center was badly looted, although some faculty were able to hide equipment in their homes before the war ended. The center and other research entities will serve as partners on the program so that skills are transferred and wetlands management approaches can be institutionalized in Iraq.
- *Established working relationships with national and district level Ministry of Water Resources officers and obtained some flow data.* The team worked closely with the Ministry of Water Resources (MWR) officers at the national and district levels. Both accompanied the team during its visits, collecting data, conducting interviews, and discussing program options actively. We see this as the first step toward their full participation. The team was able to collect some flow data during the visit from one district office. Visits to the district MWR offices in Al Amarah and Al Nasiriyah indicate the need for different strategies for partnering. The Al Amarah office had been entirely stripped, while the Al Nasiriyah office was completely intact, due to the quick thinking and effective actions of its director. As such, they are likely to play different program roles, at least in the short run.

III. NEXT STEPS

USAID's $4-million Marshlands Restoration and Management Program will provide social and economic assistance to the marsh dwellers integrated with wetlands restoration, and build the capacity of the Iraqi counterpart agencies including Ministry of Water Resources, the Ministry of Agriculture and the Ministry of the Environment. On-going interventions include:

- Implementing a river basin and hydraulic model of the marshes to improve water allocation and management through the Ministry of Water Resources and the US Army Corps of Engineers
- Equipping a soil and water quality lab at the newly established Center for Iraq Marshlands Restoration
- Implementing pilot projects in reconstructed wetlands focusing on improved waste drinking water and sewage treatment.

- Providing social economic assistance through job creation and income generating activities in agriculture/agribusiness; fisheries/aquaculture, livestock/dairy production, and date palm reproduction
- Monitoring of water quality in reflooded sites.
- Extending health care services to the marsh dwellers in collaboration with AMAR Charitable Trust Foundation
- Arranging study tours for Iraq specialists and decision-makers to visit wetlands in the US and Europe in early 2004. Short courses on wetlands reconstruction and management will be offered for ministry officials and local decision-makers.
- Building local capacity by partnering with Iraqi institutions such as the Ministry of Water Resources, the Ministry of the Environment and the University of Basrah, College of Agriculture as well as international NGO's.

Ms. ROS-LEHTINEN. Let's talk about Iraq's neighbors. What countries are helping out in trying to fix up the marshlands, if any, and what water projects taken up by neighboring countries following Saddam's destruction of the marshes would impact or prevent further efforts to restore the region.

Mr. WILSON. The neighboring countries are aware of the competing demands for water resources. The Ministry of Water resources has already approached Turkey to discuss water issues. These are issues we talk about internally at the State Department and USAID. We know it is going to take time, but the dialogue has begun.

Indeed, the Iranian government has released information to help restore the marshland there. We think we need to focus on small-scale interventions and encourage that dialogue. That is where we are playing the game, right now.

Ms. ROS-LEHTINEN. The Administration has asked for—did you want to say something, Mr. West—has asked for $50 million in the supplemental to build two regulators controlling the outflow from the marsh. These regulators are considered a first step and part of our larger effort that you were talking about. What are the other components of this effort, what is the estimated cost of those components, and what is the proposed time line being put forth for the complete restoration, if that is ever possible, of the marshes?

Mr. WEST. Really, I think there is no complete picture or plan yet. We are really at the beginning stages.

As noted, we are one of many countries, I believe, that are going to be stepping up later this month. There will be the first of the donor coordination sessions in Abu Dhabi. I believe the marshlands will be one of the major causes that does attract international funds. There is no long-term plan nor cost estimates yet, but we are optimistic that hearings such as this, publicity, the crying need of this situation, will attract the attention and the funding that it requires over the long term.

Ms. ROS-LEHTINEN. But are you depending on other countries to put forth that money, or do you think the Congress will do it? Where are those funds coming from?

Mr. WEST. Right now, we are hopeful they will be forthcoming within the existing supplemental or future allocations.

We note there are reserves that are unprogrammed currently from the existing supplemental, but as of this moment there are not additional commitments of funds within the U.S. Government resources.

Ms. ROS-LEHTINEN. What are the projected costs? In an ideal world, what would you think that it would cost?

Mr. WILSON. What our approach has been is to develop a framework of action.

In terms of projected costs, nobody has estimated that. All we can do is turn to the Everglades, and we know how much that cost. We can invite other donors, the Japanese, the Canadians, to join in partnership, and that is something that is actively being pursued by the Deputy Assistant Secretary Bud Rock in working with the administrator of USAID.

Ms. ROS-LEHTINEN. But if it seems it is going to cost so much and it seems like you could never really restore it, is it financially possible to undertake this project? What makes it worthwhile, if you are saying you do not know how much it is going to cost and you do not know where the money will come from and you do not know if it can ever be restored?

Mr. WEST. What we can say is we believe life is better there now than it was a year ago. There is never perfection in life, and this will continue to be the case.

There are many trade-offs. Clearly, the supply of water—if you look across the whole area, the Asia Near East runs from the Middle East to the south area to the Mekong region. There is tremendous competition for water from the upstream and downstream countries in subregions of countries, and, clearly, the marshland is sort of at the end of the food chain and is going to face tremendous pressures on water. So this is going to be a continuing issue, not only near-term, in restoring at whatever level. It is a long-term issue.

We do believe that incremental changes can and will be positive, so we will continue to put all the resources that we can bring to bear on this, attract others, but there is no final solution that leads to a specific number or a target that we have right now. We can continue to improve, though.

Ms. ROS-LEHTINEN. Why is this project so needed? Why is it important for the United States and for our allies to contribute toward this effort? Why are the marshlands important?

Mr. WEST. Well, there are ecological reasons, the bird life, the migration paths. There is the injustices of the past to these persons. There is also the need to bring closure to the divisions between the Shi'a, the South and the North; and this is a significant component. So there are a host of reasons, I think. You and the Committee understand this well, and hopefully the world in general starts to understand better.

Ms. ROS-LEHTINEN. And what was the extent of the damage to the various species that were evicted from the region?

Mr. WILSON. It is difficult to document that in entirety because of the lack of information, lack of baseline information from the previous regime.

We do know that the fisheries in the Gulf, for example, have suffered tremendously; and that is due in large part to the destruction of marshlands.

The documented rich biodiversity of fauna and bird life has also been recognized but not terribly well-documented. It has suffered,

too. So one of the intentions of our efforts was initially to establish that baseline and then to follow the changes over time.

Ms. ROS-LEHTINEN. What about the reintroduction of animals to the area? How is that going to be done, if it is possible?

Mr. WILSON. We are being careful to make sure that such reintroduction is done of native species to the best of our ability. For example, in the fisheries we do not want to encourage exotics, but we have no intent to pursue active reintroduction of species into the area.

Ms. ROS-LEHTINEN. I know we will have another witness to talk about the impact on human beings, but can you elaborate what—the extent of the damage done to the marshlands in terms of human lives, if that area can be restored to its condition prior to the damage done by Saddam Hussein? Will Marsh Arabs return to live in this area?

Mr. WILSON. We had supported a survey of the population in the area. It is known that the previous population was 200 to 500,000 people, Marsh Arabs. We know that the number was terribly reduced during the destructive and malicious interventions of the regime and went down to perhaps 40,000 or so. That number has now been recently documented and has gone back up to 70,000. We know there are about 100,000 people who are refugees who will probably be returning.

It is also true that, given the destruction of the marshlands and the lack of availability of the water and the social and complex dynamics of the region, that you are going to have people coming back. Some of them do want to go back to life the way it was, and many do not, and they already have expressed that, so one of the challenges is to work with the Marsh Arabs to engage with the dialogue and see what kinds of economic opportunities do you want to see, where should the water come back to, et cetera, and that is what we are working on.

Ms. ROS-LEHTINEN. And can you expand on climate changes that may have been brought about with the destruction of the marshlands?

Mr. WILSON. We have not really deeply investigated the impact of climate changes. Certainly you have changes in flux of methane by the drying of the marshlands, but we have not documented the extent to which that has happened.

Ms. ROS-LEHTINEN. And what about the health concerns for either humans or animals living in the area resulting from the damage occurred from draining the marshes?

Mr. WEST. We know that, in general, as indicated by infant and child mortality, health situations certainly over the last decade in Iraq broadly has degenerated rapidly.

We are at the beginning of a restoration of the public health services. Clearly, the marshlands will be not only included but highlighted in terms of the restoration of services because they were so cut off during the Saddam regime.

Specifically, the population there is more cut off from water resources. We note within a week or so we do expect the restoration of the Sweetwater Canal to the Basra region, which will make a tremendous difference in terms of water supply. So there are things

that are going on right now, but the health situation is critical in this area and is being paid attention to.

Ms. ROS-LEHTINEN. Well, thank you.

Do you have any summary of statements that you would like to make?

We know that you have addressed the agricultural problems, the health concerns, but certainly the impact on human lives is the most important part of this, and that is what we will hear from our second panel. We congratulate your administrator for taking this issue on so passionately, and I hope that in the United States Congress we are able to put forth the money that you need to bring this project to fruition.

Would you like to make any summary statements?

Mr. WEST. Thank you, Madam Chairwoman.

We just want to thank you, again, for your leadership on this issue.

Ms. ROS-LEHTINEN. I knew I wanted you to say something.

Thank you so much, and please give the best to the Administrator for us. Thank you so much.

We would now like to introduce the second panel.

We are going to have Dr. Fernando Miralles-Wilhelm, the Assistant Professor of the Department of Civil, Architectural and Environmental Engineering at the University of Miami. Also, Doctor Azzam Alwash, the Senior Project Advisor for Eden Again; and as I said, we have put your letter as part of the record.

Dr. Miralles-Wilhelm, I note that Dr. Shalala, the wonderful president of the University of Miami, was in the marshlands during her time in the Peace Corps and now she has witnessed their value firsthand. I appreciate President Shalala's interest in your work, Doctor, in restoring this very valuable area of the world; and I am glad that we are looking at the Everglades for a model of both what could be done and should be done in restoring the marshlands. I look forward to hearing you compare both projects and understanding better what interest the University of Miami has and what expertise you can lend into this project. Of course, Dr. Alwash, you know this firsthand; and we very much look forward to hearing your testimony this morning.

So we will begin with Dr. Miralles. Muchas gracias.

STATEMENT OF FERNANDO R. MIRALLES–WILHELM, ASSISTANT PROFESSOR, DEPARTMENTS OF CIVIL, ARCHITECTURAL AND ENVIRONMENTAL ENGINEERING, UNIVERSITY OF MIAMI

Mr. MIRALLES-WILHELM. Madam Chairwoman and distinguished Members of the Subcommittee, my name is Fernando Miralles-Wilhelm. I am an Assistant Professor in the Department of Civil, Environmental and Architectural Engineering at the University of Miami, with concurrent academic appointments at the Rosenstiel School of Marine and Atmospheric Sciences and the University's Center For Ecosystems Science and Policy. My academic and professional background is in water resources and environmental engineering. I graduated with a Ph.D. degree from MIT in 1992.

For the past 12 years, I have combined my career in academia with a consulting practice, working with engineering firms and

water resources projects on all five continents. My research and professional activities have been focused on the hydrology of vegetated projects, such as wetlands, and on water use for competing purposes in the context of sustainable development.

I am honored and privileged today to have the opportunity to address you to discuss a matter of great importance to the future of the Iraqi people, an enterprise to which we Americans find ourselves deeply committed, which is the restoration of the southern Iraqi marshlands.

Since I was asked to participate in this hearing, I struggled with the focus of my testimony because of my background as an academic, a practicing professional, as well as an environmentally concerned citizen. I decided I would present these three components of the southern Iraqi marshlands, since it is difficult to disassociate one from the other and since they are intertwined with what the problems are and how they can be fixed, and hopefully I will be able to do this under 5 minutes.

The Mesopotamia Marshlands, Ahwar in Arabic, associated with the Tigris and Euphrates, once inundated 20,000 square kilometers in southern Iraq and Iran. These complex ecosystems consisted of marshes and lakes that provided diverse populations of fish and wildlife as well as the wetlands-dependent people known as the Madaan or Marsh Arabs.

Some consider this vast marsh the site of the biblical Eden. Water management during the later years of the Baath regime was based on water diversion actions directed toward punishing the resistance movement that sought refuge in the Ahwar in the early 1990s. They have dried up to approximately 5 percent of their former extent, causing extensive salination of the soils in this arid climate. Endangered species of birds are also threatened along major flyways. Saltwater also has intruded into waterways, adversely affecting local fresh water fisheries. The Madaan culture has essentially been destroyed, in violation of its members' human rights.

Ecological and water resource management changes in the Tigris and Euphrates River watershed have had and will continue to have profound political, economic, environmental and cultural/ethical consequences in the countries composing the watershed: Turkey, Syria, Iran, and Iraq.

The Euphrates originates in Turkey, passes through Syria and ends in Iraq and has been a matter of contention for a long time. The Tigris flows through Turkey and Iraq. It is developed on the Turkish side of the border, though not as extensive as the Euphrates, and has caused strife in Iraq.

Iraq and Iran collectively share the al Alwar in Arabic and literally translates to the marshes in English.

The Alwar contain social and political resources. Beneath the marshes lies one of the largest contiguous oil reserves in the world. This reserve is mostly undeveloped by the Iraqis, but the Iranians have a large number of oil fields on their sides of the marshes.

Iran and Iraq also share the Shatt al-Arab estuary formed by conjoining of the Tigris and Euphrates and the Karun River which flows from Zagros Mountains in Iran into the estuary. Control of

this important waterway for maritime traffic was one of the factors that led to the Iran-Iraq conflict of the 1980s.

Increasing pressures for water supply and agriculture and the rise of the petroleum industry in Iraq has resulted in the situation where the demand for water exceeds the hydrologic capacity of the watershed. This pressure has resulted in the rapid degradation of the Tigris and Euphrates ecosystem. The primary cause of this loss of the habitat is the alteration of natural processes essential to sustaining them. Such processes has been altered by anthropogenic activities, the pollution of tributary streams and construction of drainage canals for oil and gas exploration and production.

The continued loss of these marshes threatens to collapse the entire Ahwar ecosystem and impede its many functions, particularly fishing and the protection of a large urban population and infrastructure. The marshlands serve as the wintering grounds for migratory birds. They are also nursing grounds for shrimp migrating up from the Arabian Gulf, important for states such as Iraq, Iran, Kuwait and Saudi Arabia; and, of course, the marshes also provide sustenance and livelihood to the Marsh Arabs.

During the regime of Saddam Hussein, the water policy was dominated by three objectives: One, destroy the marshlands and kill off the Marsh Arabs, who had been a major source of political opposition to his regime; two, expand short-term agricultural production by draining wetlands and making more water available for irrigation; and, three, close down the shallow Arab waterway to maritime traffic by diverting the flow through canals, thus lowering water depth in the width of the estuary.

The first of these was a crime against humanity designed to remove political opposition to Saddam's regime against the Marsh Arabs.

The second objective was undertaken despite major socio-economic and environmental consequences inherent in the loss of so much prime wetlands and despite the likely long-term adverse economic consequences.

The third objective was undertaken toward the end of the Iran-Iraq war to deprive Iran of the Shatt al-Arab, disrupting the ecosystem and causing damage to the fragile marine lagoon system of Khor al-Zubayr. It is essential these be reversed in the economic security and in the environmental interests of the Iraqi people and to allow the Marsh Arabs to resume their way of life in any way they choose.

The Iraq marshlands have also had a high impact on the education sector, a condition that has been exacerbated by the unstable economic and political climate that has plagued the country for the past 25 years. A week ago, I had the privilege of discussing in person the situation of Iraqi universities with the President of the University of Basra, Dr. Salman D. Salman.

Years of inflicted state control in Iraq have left the university severely deteriorated, not only physically with aging infrastructure, but also morally, with academic isolation taking its toll on the capacity of the country to provide solutions in all areas of knowledge.

The university is in great need of reconstruction and refurbishing of facilities on its various campuses, as well as equipment and materials necessary for education and research. The reconstruction of

the higher education sector in Iraq, which has been the focus of recent funding activities by USAID, needs to be driven by a common theme that will act as a catalyst and thread together different parts of the university and its interaction with society.

I am convinced, based on my experience in Miami with the Everglades and from other cases around the world, that the restoration of the Iraqi marshlands is that common theme that can spark the building of capacity necessary to help reconstruct the higher education sector in southern Iraq.

The marshlands will give these universities a mission, a purpose to focus their rebuilding. Rebuilding the higher education sector in Iraq is a key component of Iraq reconstruction in my view, because research and education are the link between Iraq and the rest of the world. It is the key to the advancement of democracy in the country and its long-term sustainability.

So what can we do?

Several agencies and institutions present at this hearing, such as USAID and the Iraq Foundation, have specific proposals and projects ongoing to address the restoration of the southern Iraqi marshlands. In the case of the University of Miami, in my full testimony you will find a specific proposal, Iraq-AWARE, advancing watershed research and education in the southern Iraqi marshlands.

The building plan is to be undertaken by United States participating higher education institutions in close collaboration with our Iraqi counterparts. The primary objective of Iraq-AWARE is to develop a program which will address the scientific, technological and policymaking aspects of the Ahwar wetland restoration. This program will build a pool of environmental, ecological, and social sciences. This will be capable of addressing the competing problems of water supply, energy generation, socioeconomic development and degradation within the Tigris and Euphrates watershed. We have already started the implementation of this program with some limited funding at the University of Miami.

It is really a joint effort between the Center for Ecosystems Science and Policy at UM, the Center for Wetlands at the University of Florida, and the following institutions in southern Iraq: The University of Basra, the Basra Institute of Technology, and the Basra Museum of Natural History.

We propose to continue working jointly with Iraq-AWARE in country to build the policymaking capacity that will enable the development of a comprehensive restoration plan for the Ahwar marshlands. This will be sustained through an in-country knowledge base at the higher education level with a higher education plan. It is anticipated this plan will be similar to other experiences of our team, including the restoration of the Florida Everglades, which essentially is our team's backyard.

The proposed research and infrastructure building plan will include a suite of viable approaches, developed at a programmatic level, to develop procedures for further implementation of specific restoration projects.

I want to point out that the costs of inaction on our part are incalculable. In this case, as in other complex situations, there is a

short window of opportunity where positive action can go a long way to determine the sincere intentions of our government.

Limited funding, just $4 million, have been provided to date through USAID and ancillary activities. In the context of what is needed, this amount, although seemingly generous in the eyes of some, provides for limited relief compared to the extent of destruction brought about by the Saddam Hussein regime.

More funding is required to fund the efforts continuing ongoing, such as USAID, the Iraqi Foundation, and the University of Miami. Absent of this funding, the Ahwar ecosystem as we know it today will continue to deteriorate. Without our contributions, the marshlands are likely to experience future water shortage, vegetation die-offs and reducing nursery functions. Southern Iraq will experience water shortage problems. The continued deterioration of the marshlands will lead to social unrest and political instability in the region. The democracy we are striving to forge in the country will be threatened.

This project cannot just be about the environment. It is also about the people in Iraq and the democratic stability in the region.

My conclusion: In the southern Iraqi marshlands we have a historic opportunity to correct past mistakes and save it for future generations while at the same time nurturing Iraq's democratic viability. The reconstruction effort in Iraq enjoys an unprecedented level of broad-based bipartisan support, reflecting a partnership of which we are very proud among the State of Florida, the Federal Government and concerned citizens.

We appreciate your leadership and commitment, Madam Chairwoman and distinguished Members of the Subcommittee. In order to truly succeed, this commitment must continue; and we look forward to working with the Subcommittee in the restoration of the marshlands.

Madam Chairwoman, this concluded my statement. Thank you for the opportunity to address the Committee, and I will be pleased to answer questions.

Ms. ROS-LEHTINEN. Thank you so much, and we thank the University of Miami for its leadership on this issue.

[The prepared statement of Mr. Miralles-Wilhelm follows:]

PREPARED STATEMENT OF FERNANDO R. MIRALLES–WILHELM, ASSISTANT PROFESSOR, DEPARTMENTS OF CIVIL, ARCHITECTURAL AND ENVIRONMENTAL ENGINEERING, UNIVERSITY OF MIAMI

Madam Chair, my name is Fernando Miralles-Wilhelm. I am an Assistant Professor in the Department of Civil, Architectural and Environmental Engineering at the University of Miami, with concurrent academic appointments at the Rosenstiel School of Marine and Atmospheric Sciences and the Center for Ecosystems Science and Policy at the University. My academic and professional background is in water resources and environmental engineering; I graduated with a PhD degree in this discipline from MIT in 1992, and for over the past 12 years, I have combined my career in academia with a consulting practice working with engineering firms in water projects in all five continents. My research and professional activities have been focused on the hydrology of vegetated environments, such as wetlands, and on water use for competing purposes in the context of sustainable development. I am pleased to have the opportunity to address you today to discuss a matter of great importance to the future of the Iraqi people, an enterprise to which we Americans we find ourselves deeply committed, the restoration of the southern Iraqi marshlands.

Since I was asked to participate in this hearing, I've struggled with the focus of this testimony because of my background as an academic, a practicing professional,

as well as an environmentally-concerned citizen. I decided I would present these three components of my vision of the southern Iraqi marshalands, since it is very difficult to dissociate one from the other, and they are all intertwined in my articulation of what the problems are and how they can be fixed, *all in under 5 minutes.*

The Mesopotamian Marshlands (Ahwar in Arabic), associated with the Tigris and Euphrates rivers, once inundated 20,000 square kilometers in southern Iraq and Iran. These complex ecosystems consisted of marshes and lakes that provided habitat for diverse populations of fish and wildfowl as well as the homeland of the ancient wetlands-dependent people known as the "Ma'dan ", or "Marsh Arabs". Some consider this vast marsh the site of the biblical "Eden". Water management during the later years of the Baathist regime was based on water diversion actions directed towards punishing the resistance movement that sought refuge in the Ahwar in the early 1990s. As a result of such actions, the marshes have dried up to less than 5% of their former extent, causing extensive salination of the soils and an extensive unsaturated zone in this arid climate. Endangered species of birds are threatened by the marshland loss along major flyways. Salt water has also intruded into waterways, adversely affecting local freshwater commercial fisheries. The Ma'dan culture has essentially been destroyed, in violation of its members' human rights.

Ecological and water resources management changes in the Tigris-Euphrates watershed have had, and will continue to have, profound political, economic, environmental and cultural/ethnical consequences in the countries composing the watershed: Turkey, Syria, Iran and Iraq. The Euphrates originates in Turkey, passes through Syria and ends in Iraq, and has been a matter of contention for all three nations. The Tigris flows through Turkey and Iraq; its development on the Turkish side of the border, though not as extensive as on the Euphrates, has caused strife between Turkey and Iraq. Iraq and Iran share the extensive marshes, collectively called "Al Ahwar" in Arabic and literally translates to "The Marshes" in English, at the southern reaches of the Tigris-Euphrates watershed. The Ahwar contain important ecological, social, and mineral resources. Beneath the marshes lies one of the largest contiguous oil reserves in the world. This reserve is mostly undeveloped by the Iraqis, but the Iranians have a relatively large number of oil fields on their side of the marshes. Iran and Iraq also share the Shatt al-Arab estuary formed by the joining of the Tigris and Euphrates, and the Karun river that flows from the Zagros mountains in Iran into the Shatt al-Arab north of Abadan. Control of this important waterway for maritime traffic was one of the factors that led to the Iran-Iraq conflict of the 1980s.

During the Baathist regime of Saddam Hussein, water policy was dominated by three objectives: (i) expand short-term agricultural production by draining wetlands and making more water available for irrigation; (ii) destroy the marshlands, and with them the ability of the Marsh Arabs (who had been a major source of political opposition to Saddam Hussein) to maintain a degree of independence from the regime; and (iii) close down the Shatt al-Arab waterway to maritime traffic by diverting the flow through canals to Khor al-Zubayr, thus lowering water depth and width of the estuary.

The first of these objectives was undertaken despite major environmental consequences inherent in the loss of so much prime wetlands, and despite the likely long-term adverse economic consequences. The second was a massive human rights violation. The third was undertaken toward the end of the Iran-Iraq war to deprive Iran of the Shatt al-Arab, disrupting the estuarine ecosystem, and causing catastrophic damage to the fragile marine lagoon system of Khor al-Zubayr. It is essential that these actions be reversed in the economic and environmental interests of the Iraqi people, and to allow the Marsh Arabs to resume their way of life if they so choose.

Increasing pressures for water supply and the rise of the petroleum industry have added to the agricultural demand, resulting in a situation where the demand for water exceeds the hydrologic capacity of the watershed. This pressure has resulted in a rapid degradation of the Tigris-Euphrates watershed ecosystem. The primary cause of this massive loss of wetland habitat is the alteration of natural processes essential to sustaining them. Such processes have been altered by anthropogenic activities, such as the construction of levees, the pollution of tributary streams, and construction of drainage canals for oil and gas exploration and production. The continued loss of these marshes threatens to collapse the entire Ahwar ecosystem and impede its many functions. These functions include the provision of habitat to support commercial fishing and the protection of a large urban population and critical infrastructure (e.g., energy, transportation, industrial) from damaging floods and storm surges. The marshlands act as wintering grounds for migratory birds along the West Siberian-Caspian-Nile flyway. They are also nursery grounds for shrimp migrating up from the Arabian Gulf, which are of commercial importance to Gulf

states such as Iraq, Iran, Kuwait and Saudi Arabia. The marshes also provide sustenance and livelihood to the Marsh Arabs.

The Iraqi marshlands have also had profound impacts on the education sector, a situation that has been exacerbated by the general economic and unstable political climate that has plagued the country for the past 25 years. Just one week ago, I had the privilege to discuss in person the situation of Iraqi universities with the President of the Universty of Basrah, Dr. Salman D. Salman. Years of inflicted state-control in Iraq have left the universities severely deteriorated, not only physically with aging infrastructure, but also morally, with academic isolation taking its toll on the capacity of the country to provide solutions to its problems in all areas of knowledge. The university is in great need of reconstruction and refurbishing of facilities on its various campuses, as well as equipment and materials necessary for education and research. The reconstruction of the higher education sector in Iraq, which has been the focus of recent funding activities by USAID, needs to be driven by a common theme that will act as a catalyst and thread together different parts of the university, and its interaction with society. I am convinced, based on our experience in Miami with the Everglades, and from other cases around the world, that the restoration of the Iraqi marshlands is the common theme that can spark the building of capacity necessary to help reconstruct the higher education sector in Iraq. The marshlands will give these universities a mission, a purpose to focus their rebuilding. Rebuilding the institutions of higher education in Iraq is a key component of Iraq reconstruction, as research and education are the link between Iraq and the rest of the world, a key to the advancement of democracy and its long term sustainability in the country.

What can we do?

Several agencies and institutions present in this hearing (USAID, the Iraq Foundation) have specific proposals to address the restoration of the southern Iraqi marshlands. In the case of the University of Miami, in my full testimony you will find a specific proposal: *Iraq-AWARE*, Advancing Watershed Assessment, Research and Education in the southern Iraqi marshlands. *Iraq-AWARE* is a comprehensive research and education infrastructure and capacity building plan to be undertaken by US participating higher education institutions, in close collaboration with our Iraqi counterparts. The primary objective of *Iraq-AWARE* is to develop a long-term program that will address, for the first time in Iraq, the scientific, technological and policy/decision-making aspects of the Ahwar wetland restoration. This program will build an indigenous base of expertise in wetland ecology, hydrology, environmental engineering and social sciences. This built in-country expertise will be capable of addressing the competing problems of water supply, energy generation, socioeconomic development and ecosystem degradation within the Tigris-Euphrates watershed. We have already started the implementation of this program with some limited in-house funding at the University of Miami.

We propose to continue working jointly with our *Iraq-AWARE* in-country team members to build the human, scientific, technological and policy making capacity that will enable the development of a comprehensive restoration plan for the Ahwar marshlands. This capacity building will be developed and sustained through an in-country knowledge base seeded at the higher education level through a carefully designed research and education plan. It is anticipated that this plan will be similar to other experiences of our team, including the restoration of the Florida Everglades (our team's "backyard"), the largest ecosystem restoration program ever funded. The proposed research and education capacity and infrastructure building plan will include a suite of viable alternative restoration approaches, developed at a programmatic level, as well as recommended processes and procedures for further evaluation and implementation of specific restoration projects.

Iraq-AWARE is a joint effort among the Center for Ecosystems Science and Policy at the University of Miami, the Center for Wetlands at the University of Florida, and the following institutions in southern Iraq: the University of Basrah, the Basrah Institute of Technology and the Museum of Natural History.

I want to point out that the costs of inaction by our part are incalculable. Limited funding, just four million dollars, have been provided to date through USAID for marshland restoration work and ancillary activities. In the context of what is needed, this amount, although seemingly generous in the eyes of some, can only get us so far. More funding is required to continue the efforts already ongoing, such as those by USAID, the Iraqi Foundation and the University of Miami. Absent of this funding, the Ahwar ecosystem as we know it today will continue to deteriorate and eventually disappear. Without our contribution, the Ahwar marshlands are likely to experience future water shortages. The Shatt-al-Arab estuary will experience increased algae blooms, vegetation die-offs and hypersalinity, reducing its fisheries

and critical nursery functions. The ability to recover endangered species will be seriously impaired and as the natural environment suffers, so too will the human environment. The population of southern Iraq will experience water shortage problems as the water supply system, under pressure of continued population growth, becomes impossible to administer adequately. The continued deterioration of the marshlands will lead to social unrest and political instability in the region; the democracy we strive to forge in the country will be threatened. This project is not just about the environment, it is about the people in Iraq and the democratic stability in the region.

Conclusion

In the southern Iraqi marshlands we have an historic opportunity to correct past mistakes and save an international treasure for future generations while at the same time nurturing Iraq's democratic viability. The reconstruction effort in Iraq enjoys an unprecedented level of bipartisan support, reflecting a partnership of which we are very proud, among the State of Florida, the Federal government and concerned citizens.

We appreciate your leadership and commitment, Madam Chair, and that of the subcommittee and other members in the United States House of Representatives in bringing us this far today. If we are to truly succeed, that commitment must continue, and we look forward to working with the Subcommittee as the restoration of the Ahwar marshlands and the Iraqi universities proceed.

Madam Chair, that concludes my statement. Thank you for the opportunity to address the subcommittee on this important effort and I will be pleased to answer any questions you may have.

Executive Summary

The Mesopotamian (southern Iraqi) Marshlands, associated with the Tigris and Euphrates rivers, once inundated 20,000 square kilometers in southern Iraq and Iran. These complex ecosystems consisted of marshes and lakes that provided habitat for diverse populations of fish and wildfowl as well as the homeland of the ancient wetlands-dependent people known as the "Ma'dan," or "Marsh Arabs." Some consider this vast marsh the site of the biblical "Eden." At the end of the Gulf War in 1991, the Baathist regime stopped water from draining into the marshlands by building dikes and canals. The marshes have dried up to less than 5% of their former extent, causing extensive salination of the soils and an extensive unsaturated zone in this arid climate. Endangered species of birds are threatened by the marshland loss along major flyways. Salt water has also intruded into waterways, adversely affecting local freshwater commercial fisheries. The Ma'dan culture has essentially been destroyed.

Iraq-AWARE, (Advancing Watershed Assessment, Research and Education), our proposed Cooperative Agreement, is an integrated research and education program which focuses on the ecohydrological restoration of the Iraqi marshlands, coupled with the development of an institutional and policy framework that makes this restoration effort sustainable in the long run. **The primary objective of the proposed program is to strengthen Iraqi scientific, technological and policy/decision-making expertise to address the competing problems of water supply, energy generation, socioeconomic development and ecosystem degradation in the Tigris-Euphrates watershed.** In achieving this long term objective, this program will provide a vehicle to strengthen existing higher educational programs in Iraq through interdisciplinary collaborations involving faculty and students in engineering, natural and social sciences.

The outcome of *Iraq-AWARE* will be a blueprint for a Comprehensive Restoration Plan for the Mesopotamian Marshlands, developed and sustained through an in-country knowledge base seeded at the higher education level through a carefully designed research and education plan. It is anticipated that this plan will be similar to other experiences of our team, including the restoration of the Florida Everglades (our team's "backyard"), the largest ecosystem restoration program ever funded worldwide. Such a plan will include a suite of viable alternative restoration plans, presented at a programmatic level, and recommended processes and procedures for further evaluation and implementation of specific restoration projects. These recommendations will include science-based decision support systems for adaptive management during implementation of the plan.

Iraq-AWARE is a joint effort between the Center for Ecosystems Science and Policy at the University of Miami, the Center for Wetlands at the University of Florida, and the following institutions in southern Iraq: the University of Basrah, the Basrah Institute of Technology and the Museum of Natural History.

Section 1
Program Vision

Working in partnership with the United States Agency for International Development (USAID), the *Iraq-AWARE Team* will develop and implement a Higher Education and Development (HEAD) program in the priority sector of *Essential Infrastructure*. The *Iraq-AWARE* program is centered on strengthening technical expertise in ecosystem restoration, water resources management and institutional capacity building within the geographical region of the Marshlands in southern Iraq. The proposed program is based on a comprehensive set of research and education activities in the fields of data acquisition and management, ecology of wetlands, hydrology/water quality, sociology and anthropology, conceptual planning, financial analysis and details of implementation.

The proposed program will be carried out by a consortium of US and Iraqi institutions. In the **US**: Center for Ecosystems Science and Policy, University of Miami (US Lead); Center for Wetlands, University of Florida. In **Iraq**: University of Basrah (Iraq Lead); Basrah Institute of Technology and Basrah Museum of Natural History.

Our vision is guided by a sustainability-driven approach to restoration in the southern Iraq region following years of severe ecological, hydrologic and associated sociocultural damage inflicted by the Baathist regime, as shown in the historical portrait of **Figure 1**. This approach seeks to balance potential future socioeconomic development activities, restoration of the southern Iraq Marshlands, water supply, public health and sanitation. Our proposed program will engage USAID and our partner institutions of higher education in a vehicle to provide technical expertise to our Iraqi colleagues, Iraqi higher education administrators, faculty and students, furthering the goal of revitalizing Iraq's higher education system.

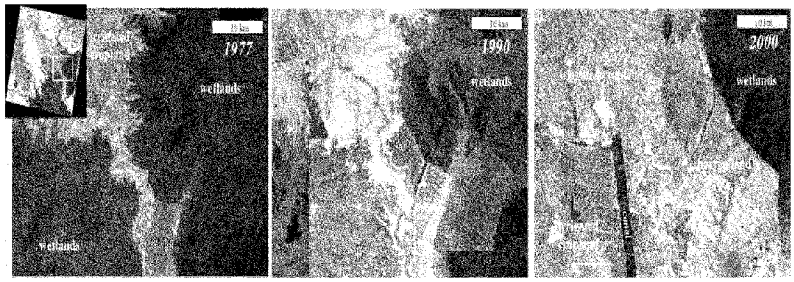
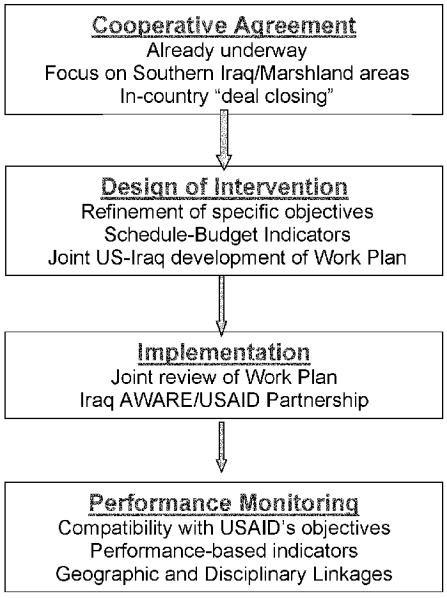


***Figure 1**: Time series remote sensing images of showing pronounced historical changes in wetlands, southern Iraq. Inset MODIS image shows location of images in relation to Basrah. The 1977 Landsat MSS image shows significant expanses of marshes (dark red-brown, reflecting healthy vegetation). These had been reduced significantly by 1990, in part related to the 1985 construction of levees and wetland drainage. By 2000, only a small portion of the former wetlands remained, as many had been drained by a built canal [the so-called "Third River"].*

We envision Iraq-AWARE as a four-phase program, conforming with USAID requirements stated in the RFA (Section C):

- *Preparation of the Cooperative Agreement*: This first phase has already been initiated in the preliminary work carried out by the *Iraq-AWARE* Program Management Team (see Section 4).
- *Design of Intervention*: This phase will be focused on detailing appropriate interventions once in-country with our Iraqi higher education partners, setting specific objectives with critical, time-linked indicators resulting in a work plan. This work plan will be a collaborative effort involving our proposed Iraqi HEAD institutions as equal partners.
- *Implementation*: This phase will constitute execution of the work plan, with research and education activities taking place jointly in the context of strengthening technical knowledge and in-country institutional support in the field of ecological restoration and water resources management.
- *Performance Monitoring*: A series of performance-based indicators to measure the level of success of the proposed program will be developed and implemented in concert with USAID's monitoring and evaluation contractor.



Our vision and proposed approach derive from a unique convergence of professionals, science and technology resources, ecohydrological restoration expertise and experience in Cooperative Agreements similar to HEAD, all critical success factors to the development of a successful program. **Table 1** summarizes these factors and how they relate to the overall program vision.

Table 1: *Iraq-AWARE* Critical Success Factors

Critical Success Factors	Relationship to Project Vision
Professionals	▪ **Engineering and Planning** – Conceptual and detailed design of environmental and water resources projects. ▪ **Ecological Sciences** – Assessment of current and future marshland restoration requirements ▪ **Policy Component** – Cultural, education, economics, sociological, anthropological, law, funding analysis, public involvement activities
Science and Technology Resources	▪ **Ecological Assessments** – Need UF Input ▪ **Hydrology and Water Resources** – State of the art water quantity and quality assessment capabilities include several large-scale modeling expertise: SWMM (Mike and XP) HMS, Computational Fluid Dynai ▪ **Remote Sensing** – Acquisition and processing of ASTER, MODIS, LANDSAT, RadarSat, SPOT and IKONOS data for quantification of spatial and temporal variability of water stages and land use (as necessary)
Ecohydrological Restoration Expertise	▪ Everglades (Florida): UM and UF researchers have been key in the conception and implementation phases of federal restoration projects (CERP). ▪ Cerrado (Brazil): CESP researchers have worked on mitigating impacts of hydrological climate variations on vegetative ecosystems. ▪ Other international – Need UF Input
Cooperative Agreement Experience	▪ CIMAS (NOAA) ▪ South Florida – Caribbean CESU (USGS, NPS, MMS) ▪ CSTARS (DOD) ▪ Other – Need UF Input

Section 2
Program Background and Objectives

2.1 *Iraq-AWARE* Background: What are the challenges?

Ecological and water resources management changes in the Tigris-Euphrates watershed have had, and will continue to have, profound political, economic, environmental and cultural/ethnical consequences in the countries composing the watershed: Turkey, Syria, Iran and Iraq. The Euphrates originates in Turkey, and passes through Syria and ends in Iraq, and has been a matter of contention for all three nations. The Tigris flows through Turkey and Iraq. Its development on the Turkish side of the border, though not as extensive as on the Euphrates, has caused strife between Turkey and Iraq. Iraq and Iran share the extensive marshes at the southern reaches of the Tigris-Euphrates watershed, which contain important ecological, social, and mineral resources. Beneath the marshes lies one of the largest contiguous oil reserves in the world. This reserve is mostly undeveloped by the Iraqis, but the Iranians have a relatively large number of oil fields on their side of the marshes. Iran and Iraq also share the Shatt al-Arab estuary formed by the joining of the Tigris and Euphrates, and the Karun river that flows from the Zagros mountains in Iran into the Shatt al-Arab north of Abadan. Control of this important waterway for maritime traffic was one of the factors that led to the Iran-Iraq conflict of the 1980s.

The Tigris-Euphrates basin reveals evidence of water management projects dating back over six millennia. Throughout this period, the power base has consistently been constructed on the wealth generated by irrigated agriculture. The historical location of this activity has been in the lower part of the basin, in what is now Iraq. The scale of development has varied from small diversion projects to major engineering works such as the Nahrawan canal built during the sixth century. After the 12th and 13th centuries, however, widespread land abandonment occurred, associated with a breakdown of the strong central government necessary for sustained widespread irrigation. Following the early civilization at Ur, and later after the rise of the Ottoman Empire, lack of proper land management led to the degradation of arable lands and encroachment of the western desert into the agricultural fields. It was only in the late 19th and early 20th century that major irrigation development was undertaken, once more in the lower part of the Tigris-Euphrates watershed. During this period, the system of water management attempted to minimize risks to crop growth. Only a small proportion of the total water in the river was utilized for human activity, and the vast majority of the water flowed unused into the Persian Gulf.

This situation changed significantly during the Baathist regime of Saddam Hussein, where water policy was dominated by three objectives: (i) expand short-term agricultural production by draining wetlands and making more water available for irrigation; (ii) destroy the marshlands, and with them the ability of the Marsh Arabs (who had been a major source of political opposition to Saddam Hussein) to maintain a degree of independence from the regime; and (iii) close down the Shatt al-Arab waterway to maritime traffic by diverting the flow through canals to Khor al-Zubayr, thus lowering water depth and width of the estuary.

The first of these was undertaken despite major environmental consequences inherent in the loss of so much prime wetlands, and despite the likely long-term adverse economic consequences. The second was a massive human rights violation. The third was undertaken toward the end of the Iran-Iraq war to deprive Iran of the Shatt al-Arab, disrupting the estuarine ecosystem of Shatt al-Arab, and causing catastrophic damage to the fragile marine lagoon system of Khor al-Zubayr. It is essential that these actions be reversed in the economic and environmental interests of the Iraqi people, and to allow the Marsh Arabs to resume their way of life.

Increasing pressures for water supply and the rise of the petroleum industry have added to the agricultural demand and resulted in a situation where the demand for water exceeds the hydrologic capacity of the watershed (see **Table 2**). This is combined with a rapid degradation of the Tigris-Euphrates watershed ecosystem. **Figure 2** below shows recent loss of marshlands in the central area of the watershed in a short period of two years. The primary cause of this massive loss of riverine habitat is the alteration of natural processes that are essential to sustaining them. Such processes have been altered by anthropogenic activities, such as the construction of levees, the pollution of tributary streams, and canals for oil and gas exploration and production. The continued loss of these marshes threatens to collapse the entire ecosystem and impede the many functions they provide. These functions include the provision of habitat to support commercial fishing and the protection of a large urban population and critical infrastructure (e.g., energy, transportation, industrial) from damaging floods and storm surges. The marshlands act as wintering grounds for migratory birds from northern Europe, Siberia, and the North Asian steppes. They are also nursery grounds for shrimp migrating up from the Arabian Gulf, which are of commercial importance to Gulf states such as Iraq, Iran, Kuwait and Saudi Arabia. The marshes also provide sustenance and livelihood to the marsh people, who are the indigenous people of the region.

Table 2: Water Capacity of the Tigris (left) and Euphrates Rivers and Consumption Targets of its Riparians
(in billion cubic meters per year)

Countries	Water Capacity	Consumption Targets	Water Capacity	Consumption Targets
Turkey	25.24 (51.80%)	6.87 (13.00%)	31.58 (88.70%)	18.42 (35.00%)
Syria	0.00 (0.00%)	2.60 (4.00%)	4.00 (11.30%)	11.30 (22.00%)
Iraq	23.43 (48.20%)	45.00 (83.00%)	0.00 (0.00%)	23.00 (43.00%)
Total	48.67 (100%)	54.47 (%100.00)	35.58 (100%)	52.92 (100%)

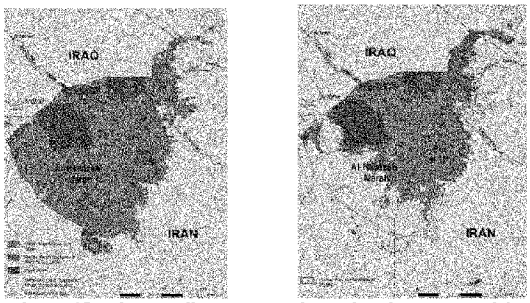


Figure 2: *Analysis of Landsat satellite imagery shows that the surviving Mesopotamian marshlands declined by 30% from 1,084 square kilometers in 2000 (left) to 759 square kilometers in 2002. At this rate of loss, the marshes are likely to totally vanish within the next five years. (Maps Copyright © 2002 UNEP/DEWA/GRID-Geneva).*

2.2 Objectives of the Proposed Work

In light of the recently initiated reconstruction efforts in Iraq, it is important to recognize that a new approach is needed immediately to halt the catastrophic collapse of this ecosystem and restore parts of the system that have already been damaged. This approach must **holistic** and **integrated**, one that is **practicable** in phases from smaller to larger scale ecosystem restoration projects, and one that is **sustainable** over the next decades. Restoration of the marshes needs to be initiated in concert with other reconstruction efforts in order to ensure timely rehabilitation of the affected ecosystem without causing further damage.

The *Iraq-AWARE* Program is a joint planning and design effort undertaken by our proposed US participating higher education institutions, in close collaboration with USAID and our Iraqi HEAD counterparts. The purpose of this program is to develop a comprehensive education-research-policy framework to address the co-existing challenges of water supply, energy generation, socioeconomic development, wetland loss and ecosystem degradation in the Tigris-Euphrates watershed over the long term (decades). This framework will consist of a suite of viable alternative restoration plans, presented at a programmatic level, and recommended processes for further evaluation and implementation of specific restoration projects.

The *Iraq-AWARE* project will be guided by the following objectives of the USAID HEAD Program:

- *Restore Economically Critical Infrastructure*: Sustainability of the watershed ecosystem and hydrologic resources is critical for long-term economic development of the southern Iraq region. This sustainability hinges on the ability of the watershed to perform its essential ecohydrological functions (water circulation, nutrient cycling in the marshlands). The proposed program will focus technically on the restoration of the ecosystem to the highest practicable acreage of productive and diverse wetlands.
- *Support Essential Health and* ***Education*** *Services*: The *Iraq-AWARE* program will be used as a vehicle to educate and train a new generation of ecosystem scientists and

managers, as well as higher level educators in southern Iraq, and to revitalize the tertiary level education infrastructure of our partners in the area of Basrah and the Marshlands.

- *Expand Economic Opportunity*: The proposed program will develop a comprehensive plan that is coordinated and consistent with other major land use and infrastructure features, particularly with respect to agriculture, commercial fisheries, and oil and gas production. It is only through the restoration of the natural ecohydrological infrastructure of the marshlands that economic activity in this geographical area will flourish again.
- *Improve Efficiency and Accountability of Government*: The proposed program will foster social and political stability by helping meet citizens' basic needs of water supply and environmental sustainability within their communities. The policy component of the program will provide the opportunity for Iraqis to participate in public decision-making and will also support the preparation and implementation of an appropriate legal framework for decentralized government. The technical component will strengthen the capacities of local administrations to manage and deliver services such as water supply, higher education, and healthcare.

In addition to these HEAD programmatic objectives, it is important to note that building a comprehensive research and educational program that will strengthen the higher education sector in Iraq also requires posing fundamental questions upon which scientific inquiry and educational planning can be based. The Iraq-AWARE program is not about simply exporting US educational offerings and scientific/technical know-how, but more about seeding the grounds for the flourishing of an indigenous academic activity that in our proposed case is based on the ecohydrology of the southern Iraqi Marshlands.

In this regard, preliminary fundamental science and policy questions posed by the *Iraq-AWARE* program include the following:

(1) What is the current state of scientific knowledge and understanding of the causes of watershed and ecosystem degradation, i.e., is there agreement on the problem? What is the current state of scientific knowledge and understanding of the efficacy of alternative watershed restoration measures, i.e., do we know enough to solve the problems? What is the current state of social science understanding of issues in the coastal region, as they relate to the plan, i.e., how will restoration efforts affect the socioeconomic dynamics of the region?
(2) What types of data collection, applied research, modeling and assessment tools will be required to answer these questions, e.g., remote sensing, systems modeling, field techniques? What types of relevant data collection, applied research, modeling and assessment tools currently exist? How should data collection, modeling, and assessment needs be prioritized?
(3) What are the most serious deficiencies, problems and needs in institutional capacity for management of a complex and expansive watershed restoration program? What institutional, policy and legislative measures and changes are needed to achieve program goals? As the plan progresses from concept to implementation, how will adaptive assessment be instituted and practiced?

Section 3
Research and Educational Plan

3.1 Science and Policy Motivation

The southern Iraqi Marshlands are a hydrologically-controlled ecosystem, in which either an excess or deficit of water and nutrients determine its structure and function. Such systems have complex dynamic characteristics that depend on interrelated links among climate, soil and vegetation. For instance, vegetation exerts important controls on the water and nutrient balances of ecosystems and is responsible for feedbacks to the atmosphere [Moreira *et al.*, 1997, Sternberg *et al.*, 2002]. At the same time, climate and soil exert key influences on patterns of vegetation distribution [Ridolfi *et al.*, 2000, Porporato *et al.*, 2001]. Vegetation plays a special role in hydrologically-controlled ecosystems, as plant physiological processes condition water and nutrient balances. Plants also are impacted by the climate and hydrologic conditions they contribute to produce. The links between water and nutrient availability in the soil (i.e., soil moisture and nutrient concentrations), and vegetation create direct and indirect effects. Soil moisture and nutrient availability have direct impacts on the essential physiological processes of individual plants, including transpiration, photosynthesis and biomass production [e.g., Larcher, 1995, Lambers et al., 1998]. They also indirectly control many other vital aspects for vegetation such as absorption of nutrients [Scholes and Walker, 1993] and soil temperature [Lambers et al., 1998]. The availability of water and nutrients is also a driver for competition mechanisms among plants, whose differences in water usage can produce complex spatial and temporal dynamics [Huston and DeAngelis, 1994, Rodriguez-Iturbe et al., 1999].

The central scientific question driving the proposed research activities of the *Iraq-AWARE* program is to **quantify the ecohydrological changes in the southern Iraqi marshlands that have occurred over space/time, and how these changes have translated into social, economic, anthropological and cultural impacts**. This quantification will be sought at a systems level, i.e., assessing the magnitude of stocks and fluxes of water and nutrients, as they couple and aggregate into the spatial and temporal organization and adaptation mechanisms at the ecosystems level. This **central scientific question** will **provide information essential for policy-makers determining the specifics of marshland restoration activities**.

From a policy standpoint, restoring marshland ecohydrological conditions will be greatly complicated by legal, economic, social and political considerations. As we have learned from experience with other large-scale watershed projects, including dealing with the restoration of the south Florida Everglades, the problems cannot be effectively approached by first obtaining answers to the political and legal issues, and then leaving the matter thereafter in the hands of the scientists and engineers. Instead, success requires a highly interactive approach. Environmental policy considerations, the desires of the stakeholders, economic consequences, and legal requirements must all be considered. Feasible plans to meet those objectives must be outlined, and the views of

the relevant parties sought. In short, development of successful restoration plans requires inputs from U.S. and Iraqi experts in science fields as diverse as ecology, agriculture, geology, hydrology, climate forecasting, and engineering, but also sociology/anthropology (determining what outcomes the Marsh Arabs want, for example), economics, regional politics (attempting to anticipate likely Iranian, Turkish and Syrian reactions), and, in this case, international law.

The team assembled for this project has studied various hydrologically-controlled ecosystems that have similar spatial and temporal characteristics: both are influenced by the interplay between **natural science** (hydrologic, vegetative) and **social science/policy** (economic, regulatory, cultural) aspects. **We seek to quantitatively and comparatively evaluate this interactive relationship on hydrologically-controlled ecosystems in the proposed research and education activities by comparing the Marshlands in southern Iraq and the Everglades of South Florida**. Undoubtedly, differences in the natural and policy aspects are significant. Understanding these similarities and differences is a key step towards building a roadmap for the reconstruction of the southern Iraqi Marshlands and will provide the framework for the HEAD activities proposed in *Iraq-AWARE*. We illustrate the linkages between research and education activities proposed here in **Figure 3**.

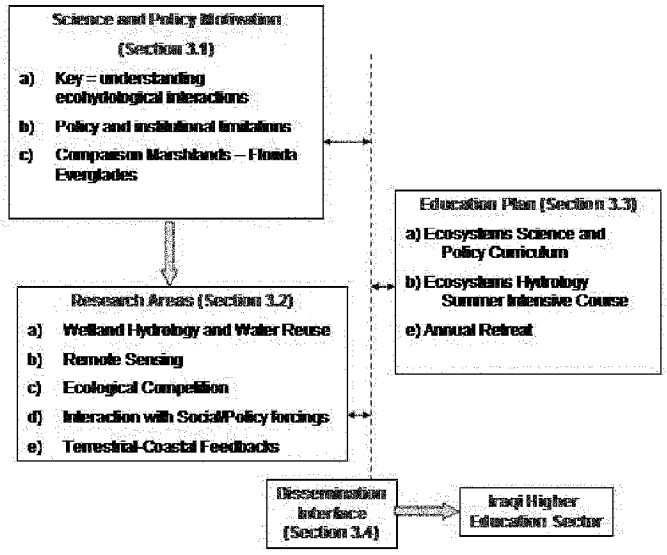


Figure 3: Outline of Proposed HEAD Activities

3.2 Example Research Areas

The proposed research will focus around the following series of representative topics on the relationship between science and policy in the context of ecosystem vegetation-hydrologic response and feedback dynamics in space and time:

(1) Ecohydrology of the southern Iraqi Marshlands: Integrated ecohydrological models (marshland vegetation, surface water and groundwater) will be used to analyze the hydrologic forcing-response dynamics of the Marshlands at the ecosystem scale. This research entails the development, parameterization, calibration and application of these models to address specific issues related to the hydrologic restoration of this ecosystem: *(i)* Mitigation of impacts of dams on downstream ecosystems, and re-evaluate the role of existing and planned engineering hydraulic works; *(ii)* Re-establishment of the flood regime and determining the extent to which existing damage can be reversed, which is likely to vary spatially, e.g., the Central and Hammar marshes are severely deteriorated, while the al-Hawayza marsh (east, close to the Iranian border) is in better condition currently; (iii) Expected impacts of marshland re-flooding on the distribution of water supply in the region, e.g., impacts on existing irrigation, flood protection, water quality and population distribution; (iv) Designation of protected areas, and their optimal size and location, in an effort to balance species preservation and socioeconomic development, i.e., the intent is not to transform the Marshlands into an ecological sanctuary, but rather to develop it in a way that it becomes a place where "people live and breathe".

(2) Remote Sensing of Watershed and Marshland Ecosystem Dynamics: Spatial and temporal patterns in the marsh coverage of the watershed developed and continues to change in response to various forcing mechanisms (e.g., climate or hydrology) and feedbacks. Remote sensing data can help address questions of how these patterns evolved and how they might respond to future changes. **This technology offers benefits in terms of its ability to obtain environmental data with unparalleled levels of accuracy vs. spatiotemporal resolution. It also facilitates the early start-up of the project, since the data can be collected without personnel located *in-situ*, therefore minimizing safety and security concerns**. Archived remote sensing imagery also provides data on past conditions. In this regard, this research project will utilize the newly-established Center for Southeastern Tropical Advanced Remote Sensing (CSTARS) at the University of Miami. This station enables reduced-cost (and in some cases free) access to earth remote sensing images such as SPOT and radar data. We will exploit this capability to increase the amount of coverage available for this project. Here, we propose to map and quantify past changes in habitat characteristics and Land Use/Land Cover (LULC) in both marshlands and coastal regions using time-series remote sensing data (e.g., Munro and Touron, 1997). These maps, coupled with local data and experiences, will provide insights into linkages between the systems, addressing fundamental questions: (i) What **is** the status of these systems? (ii) What **was** the status of these systems? (iii) What **will be** the response of these systems as restoration begins and continues?

(3) Competition among vegetative species for space, water and nutrients: Changes in environmental conditions (e.g., hydrologic factors and nutrient availability) can lead to changes in an autotroph community. This has occurred in some areas of the Everglades, where the dominant, sawgrass (*Cladium jamaicense*), has changed to cattails (*Typha* sp.) in response to phosphorus (P) loading and increased flooding depth. The Florida Everglades and southern Iraqi Marshlands differ in terms of their nutrient stresses. The Everglades are exposed to nutrient fluxes from intense agriculture (e.g., sugar plantations upstream), whereas the upstream agriculture along the Euphrates and Tigris are not as intensive as in central Florida. Thus, changes in the nutrient regime are not as dramatic in the marshlands. Rather, one of the main causes of disruption to the Iraqi marshes ecosystem over the last two decades has been the movement of soil into the marshes. The natural evolution within the marshland ecosystem starts with growth of hornwort (*Ceratophyllum demersum*) along the river banks, which act as filters capturing suspended sediments to redeposit along the banks. As sediment deposition accumulates over time, the system allows for the establishment of herbacious plants such as reed beds, where reeds are harvested and used by the Marsh Arabs for building their houses and diwans. Eventually the reed beds are replaced by woody shrubs and trees as land area expands. Adapting this to typical terrestrial situations requires modeling the spatial spread of nutrient and suspended sediments in a realistic manner.

(4) Interaction between Marshland restoration efforts and the social/policy context of the southern Iraqi region: Restoration of the southern Iraqi Marshlands is complicated by a number of policy considerations: *(i)* Possible political, social and domestic legal limitations on restoration; the ongoing loss of marshlands in Iraq and Iran must be halted, and halted quickly. Returning to the level of marshlands that existed prior to the efforts of the former Baghdad regime to alter the situation, however, may not be what all relevant parties want, or even what all the Marsh Arabs want. Indeed, there is a potential for conflict among varying interest groups within Iraq on these issues. If some farmers are now utilizing former wetlands to grow crops, to what extent do they have legal rights under Iraqi law? *(ii)* Possible economic limitations on restoration**:** Some of the projects undertaken by the Baathists, no matter what their motivation, may turn out to have been worthwhile in terms of needed irrigation, energy production, or flood control. Their elimination will have to be considered with some care. Unexpected economic consequences will also have to be carefully investigated: would changed water flows, for example, affect port operations? *(iii)* Possible international legal issues**.** The Baathist regime almost certainly violated customary international law when its wetlands projects also damaged wetlands in Iran. One can anticipate, therefore, that the Iranian government will be pleased to see the cessation of this damage. However, it is also possible that portions of the drained area in Iran have since been put to some use that would be threatened if the marshlands are restored. Flooding a road over Iranian objections would not contribute to a reduction of tensions in the area. An even larger legal issue is whether on-going irrigation projects in Syria and Turkey so reduce flows in the Tigris and Euphrates that full-scale restoration becomes impossible, and if so, can a legal arrangement be worked out that would provide an equitable sharing arrangement?

(5) Responses of Marine Systems to Marshland Changes: As described above, changes in flows upstream from the Marshlands of southern Iraq have had significant impact on the vegetation of the marshes and on the population that survives using those resources. We hypothesize that a similar response can be recognized downstream at the Tigris-Euphrates river delta as a result of dam building and wetland drainage. We hypothesize that the volume of freshwater and silt being delivered to the delta has decreased significantly, which would lead to pronounced ecologic and coastal geomorphic change that should be evident on remote sensing data. We will explore: *(i)* Are the timing and magnitudes of responses similar in both the Marshlands and coastal areas? *(ii)* The delta has built 130-150 km seaward in the last 5ka (Larsen and Evans, 1978). Is the coastal region now eroding, as would be expected with a decrease in sediment supply? *(iii)* How does the structure and dynamics of land use/cover change relate to socio-economic development, macro-scale human driving forces, and upstream marsh restoration? We expect to derive empirical predictive process-response models that include human factors. Similarly, as the marsh is restored, we expect there to be concomitant changes downstream at the delta and in the croplands in those areas. By monitoring the system with high-resolution imagery (see #1 also), we can directly monitor these changes, observe links, and test the predictions of our process-response models. These observations, and further model refinements, will in turn lead to enhanced predictive models for immediate and direct application to policy issues, because coastal fisheries are important in the northern Arabian Gulf. These fisheries have experienced a significant decline, in part related to the loss of spawning grounds in the marshes.

(6) Industrial, agricultural, and residential water reuse in Iraq to reduce demands on environmental waters: Water reuse is now becoming essential to sustainable water and wastewater management worldwide, driven by population pressures and increasing water demands. Decentralized wastewater management has been proposed as an important approach to reducing costs of water delivery, recharging aquifers, and reusing water locally, bypassing industrial contamination and attendant treatment costs. Institutionalized, decentralized water supply may be complimentary to decentralized wastewater management, potentially motivating water reuse and conservation, and providing the incentive to manage water efficiently in developed areas without depending upon withdrawals from the natural system. The working hypothesis of this area is that water **reuse will be necessary** to reduce demands on marsh recharge waters. Based on the results of large scale water and nutrient budget models, water reuse plans (including decentralized systems) will be proposed and analyzed probabilistically. Available and emerging water reuse technologies will be assessed for application in the region given local geologic and climatic conditions. Mineral-mediated oxidation for disinfection and purification of water and wastewater, including oxidation of organics and co-precipitation of inorganics and metals, will be studied for application as an economical alternative for treatment and reuse. Ecological and public health risks of proposed water reuse will be assessed using predictive Bayesian methods developed previously for the Everglades system and the South Florida urbanized region.

3.3 Education Plan

The higher education system in Iraq must be re-built in this challenging period in the nation's history, and one in which it will, in **real time**, play a fundamental role in shaping the future of the country. Our Iraqi HEAD partners are faced with the challenge of teaching students who will immediately be called upon to address multinational problems, as the Marshlands are shared with Iran, Syria and Turkey. The urgency of the Marshlands degradation implies that these students will not have the luxury of purely 'textbook' learning and theoretical reflection; they will be asked to work immediately to guide the nation toward a sustainable future.

The proposed curriculum in Ecosystems Science and Policy consists of developing core courses at the undergraduate level, an intensive summer course for upper undergraduate/graduate students and an annual retreat for researchers in a collaborative symposium format. Using case studies, which will include but not be limited to the Everglades and Marshlands ecosystems, students in these courses will be exposed to the scientific, social and ethical underpinnings of natural and anthropogenic-induced ecosystem changes. The development of such a program is a primary goal which supports the strategic direction of the new Iraqi higher education system (Ministry of Higher Education, pers. comm. July 2003) for becoming increasingly interdisciplinary educational institutions, with the global environment as one of its focus. The applicability of the proposed curriculum to relevant societal problems is facilitated by the close proximity of Basrah to the southern Iraqi marshlands and of Miami to the Florida Everglades, allowing **a "backyard" local comparative approach**.

Ecosystems Science and Policy Undergraduate Curriculum: Team-taught by science and policy US and Iraqi faculty, the curriculum will be organized around a series of environmental problems of escalating complexity in which students will confront inter-twined issues of science, technology, politics, law and economics. The curriculum will expose students to basic techniques and approaches that make up the scientific method and lead to political decision-making and the formulation of public policy. Topics will alternate between science and policy areas and will include: field data collection; analysis of prepared data sets; field monitoring techniques; laboratory analysis techniques; the basics of computer modeling; components of conflict resolution; legislation and administrative rulemaking; the litigation process; elements of macro- and microeconomic analysis; cost-benefit analysis; survey research methods.

Ecohydrology Summer Intensive Course: An intensive 4-week course in ecosystems hydrology will be developed jointly by UM, UF and U-Basrah in Iraq. This course will sponsor twenty (20) upper undergraduate/graduate level students to spend two weeks working on hands-on field experiments in the Marshlands and Everglades ecosystems (two weeks on each), focusing on the following educational components and skill building: familiarity with ecohydrological instrumentation, data acquisition, interpretation of measured results and comparison with model simulations, write-up of technical reports and papers.

Annual Retreat: In this five-day annual event, each graduate student and all faculty members/investigators will report on completed, ongoing and planned research activities. Written summaries of these presentations will be compiled and reproduced to help disseminate the program's research and to serve as a record of the program activities. Student presentations will be critiqued by a panel of professionals, and awards will be made for the best presentations. All students will receive feedback from the panel to help them improve their presentation skills. The event will also provide an opportunity for discussion of professional and scientific ethics, and program self-assessment activities.

3.4 Dissemination of Proposed Research and Education

The proposed research and educational plans of *Iraq-AWARE* are consistent with National Science Education Standards [National Research Council, 1996], including students' applying "scientific knowledge and reasoning to situations similar to those they will encounter in the world outside the classroom, as well as to situations that approximate how scientists do their work," and "public communication of student ideas." It will train future scientists and policy makers for more effective communication and provide the opportunity to contribute to both science and policy aspects of the national challenges. As such, it emphasizes the observation that "scientific literacy has different degrees and forms; it expands and deepens over a lifetime, not just during the years in school."

In addition to students, the program dissemination will be targeted at scientific (faculty and researchers), professional (industry), and regulatory (government) audiences in Iraq, through a combination of the following mechanisms:

(a) The Iraq-AWARE web site will be developed as part of the University of Basrah's strategic initiative of developing an interdisciplinary research and education program in ecosystems science and policy. This web site will incorporate the findings of this project (research, curriculum, participants) and will serve as a clearinghouse for the project;
(b) Presentations at conferences, workshops and symposia, particularly those sponsored by the Marine Science Centre at the University of Basrah, which has been in operation since the mid-1970s, and has sponsored many international conferences, workshops and symposia on the themes of wetlands and wetlands restoration;
(c) Publication of scientific (peer reviewed) and professional articles;
(d) Production and distribution (downloaded from Iraq-AWARE web site) of all program contents: course materials, presentations and publications, modeling and visualization software;
(e) The integrated modeling and visualization (remote sensing) hardware setup will be used as a demonstration exercise for the annual recruitment of prospective undergraduate and graduate students.
(f) We will encourage our Iraqi collegues to develop outreach programs with primary and secondary school students. Environmental awareness begins at an early age, and our hope is that the Iraqis will educate the new generation of scientists and policy makers on the importance of their resources. Outreach programs will help to recruit new students in the field of environmental sciences and secure the continued conservation of important ecosystems in the region.

Section 4
Management Plan and Institutional Commitment

Management of the Iraq-AWARE Program will be carried out through a core virtual office, functioning simultaneously at the University of Miami and the University of Basrah, our team's two lead institutions. In Iraq, our proposed Chief-of-Party (CoP), Dr. Nasseer Idrisi, will be collocated full-time at the University of Basrah, and will work closely with the US team members, coordinated through the University of Miami. We propose this management arrangement as an **efficient** and **cost-effective** way to carry out the research and educational plans described in Section 3. It is efficient in that it will insure coordination of activities being carried out in Iraq and the US. It is cost-effective in that it will make use of in-kind administrative services provided by the two lead institutions, and will avoid the costs of establishing a "physical" program office.

The core virtual office will be supported by the co-PIs for specific research and education activities, as specified in Sections 3.2 and 3.3. This team will set policy regarding all aspects of the proposed program, initiate research activities with our Iraqi faculty counterparts, advise students on research projects, communicate with local and Iraqi government officials and NGOs, and run the day-to-day aspects of the program.

The core virtual office for the *Iraq-Aware* Program will be co-led by the proposed Principal-In-Charge, and UM President Dr. Donna E. Shalala, the Chief-of-Party (CoP), Dr. Nasseer Idrisi, who will be dedicated full-time, in-country, to this program, and by the US Program Manager/Principal Investigator (PI), Dr. Fernando Miralles-Wilhelm. We have assembled this core management team following the same integration between science and policy aspects of the southern Iraqi Marshlands that we have presented in our proposed research and educational plans.

The Principal-In-Charge, Dr. Donna E. Shalala, is the chief executive at the University of Miami, and has had hands-on working experience in the Middle East and in government, serving as US Secretary of Health and Human Services from 1993 to 2001, in addition to her extensive experience in the academic sector. Her areas of expertise are political science, education and public health. Dr. Shalala is familiar with the Arab culture. She has been involved with work in the Middle East since her days as a student, being awarded the Lebanese-Syrian Woman's League Scholarship (1958). She was later a Peace Corps volunteer in Iran (1962-1964). Since that time, she has held positions of increasing responsibility alternating in government and academia. Dr. Shalala brings to the *Iraq-AWARE* Team a seasoned approach to management of multidimensional, international problems involving the interaction of science with public policy.

The CoP, Dr. Nasseer Idrisi is a wetlands ecologist with field experience in and around the southern Iraqi Marshlands, first as a student (undergraduate and graduate) and later as a researcher at the Marine Science Centre, University of Basrah. In addition to being author of a significant number of scientific publications in the ecology of marine and

wetland ecosystems, Dr. Idrisi has in-country experience working with military units and international relief organizations, specifically in southern Iraq during wartime. We have attached two reference letters (in the supplementary section of this proposal) from US Army and United Nations officials that document this experience.

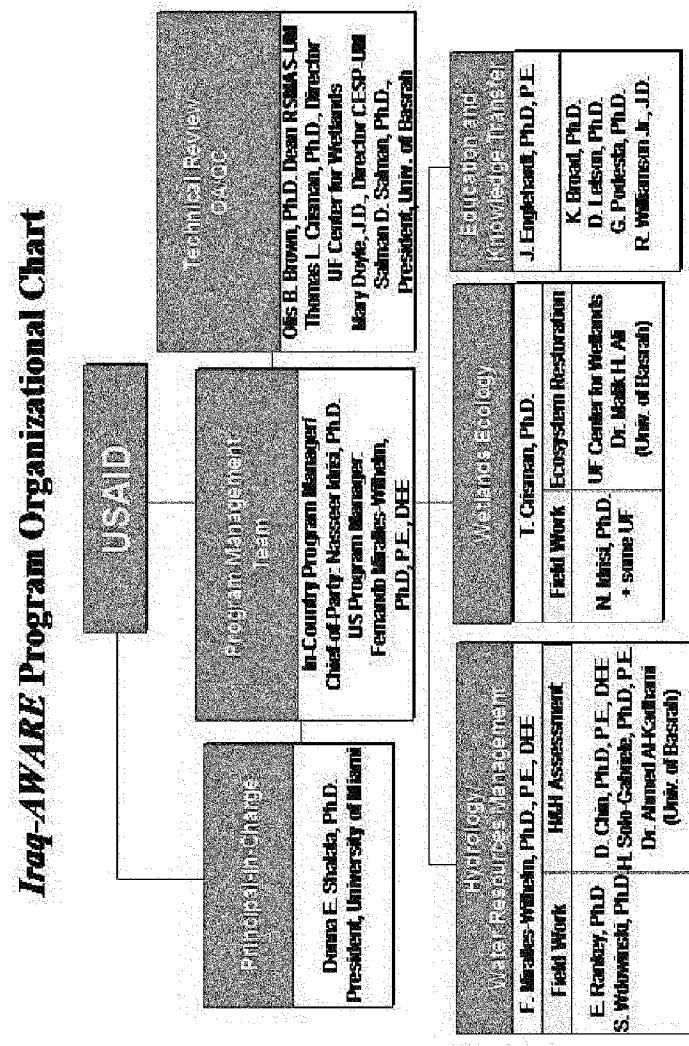
The PI, Dr. Fernando Miralles-Wilhelm is a hydrologist and water resources engineer with experience in management of multi-disciplinary, multi-institution teams during his 10+ year career in the environmental engineering consulting industry (see PI biographical sketch for details). Dr. Miralles is currently the Principal Investigator on a $1.8 million National Science Foundation *Biocomplexity* grant focused on quantifying hydrologic-vegetative interactions using a combination of modeling, remote sensing and field techniques. Dr. Miralles is also experienced in establishing and managing joint US-international academic programs overseas.

The University of Miami-University of Florida consortium has performed work for the Comprehensive E storation Program (CERP), the largest ecosystem restoration program ever funded. In addition to this, one of our US partners, the UF Center for Wetlands, is headed by Dr. Thomas L. Crisman, an internationally renown expert in ecosystem restoration. Dr. Crisman has been involved in programs similar to *Iraq-AWARE* in over 20 countries around the world. Hewill be directly involved with one of the specific research and educational areas as indicated in the program organizational chart below.

Program assessment will have a high priority. We will conduct assessments at various levels, including research productivity performance measures, course evaluations by students, self-assessment conducted during annual retreats, and follow-up of dissemination activities identified in Section 3.4. Part of the program assessment will be based on an overseeing Advisory Board composed of representatives from USAID, each participating academic unit in the consortium (Center for Ecosystems Science and Policy at UM; Center for Wetlands at UF) and from each participating non-US organization (University of Basrah, Basrah Institute of Technology, and the Basrah Museum of Natural History).

The University of Basrah will be the point institution providing staff and in-kind local support for research and educational activities in the Marshlands ecosystem, including access and field work supervision. We have attached a letter of intended support from the University's President, Prof. Salman D. Salman (attached in supplementary section), who is himself an aquatic ecologist, has worked extensively in the Marshlands, and understands our objectives and goals.

Other key project staff are included in the following organizational chart for the Iraq-AWARE program. One-page CVs for key staff are included in the supplementary section of this proposal.


Iraq-AWARE Program Organizational Chart
USAID
Technical Review Panel
Olis B. Brown, Ph.D. Dean RSMAS-UM
Thomas L. Crisman, Ph.D., Director UF Center for Wetlands
Mary Doyle, J.D., Director CESP-UM
Salman D. Salman, Ph.D., President, Univ. of Basrah
Program Management Team
In-Country Program Manager/ Chief of Party: Nasser Hisi, Ph.D.
US Program Manager: Fernando Miralles-Wilhelm, Ph.D., P.E., DEE
Principal/Senior Chiefs
Donna E. Shalala, Ph.D. President, University of Miami
Hydrology/ Water Resources Management
F. Miralles-Wilhelm, Ph.D., P.E., DEE
Field Work
E. Rankey, Ph.D
S. Witkowski, Ph.D.
H&H Assessment
D. Chin, Ph.D., P.E., DEE
H. Solo-Gabriele, Ph.D., P.E.
Dr. Ahmed Al-Kaifkani (Univ. of Basrah)
Wetlands Ecology
T. Crisman, Ph.D.
Field Work
N. Hisi, Ph.D.
+ some UF
Ecosystem Restoration
UF Center for Wetlands
Dr. Malik H. Ali (Univ. of Basrah)
Ecotourism and Knowledge Transfer
J. Englehardt, Ph.D., P.E.
K. Broad, Ph.D.
D. Letson, Ph.D.
G. Podesta, Ph.D.
R. Williamson Jr., J.D.

Section 5
Program Deliverables and Schedule

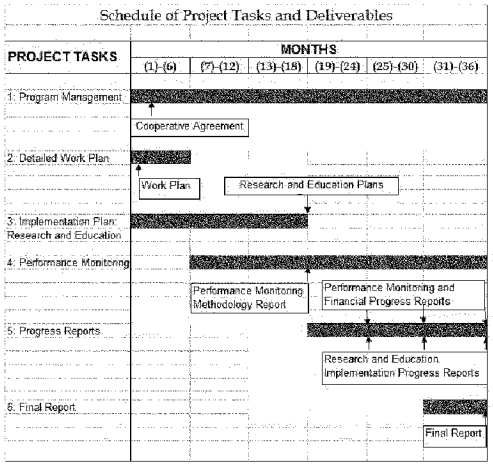
5.1 Program Deliverables

As per the research and education activities described in Section 3, the following are the proposed deliverables for this project. The *Iraq-AWARE* Team will provide five (5) draft and ten (10) final copies (including all electronic files) of these deliverables to USAID.

- ***Iraq-AWARE Volume No. 1: Cooperative Agreement***
- ***Iraq-AWARE Volume No. 2: Detailed Work Plan***
- ***Iraq-AWARE Volume No. 3: Research and Education Plans***
- ***Iraq-AWARE Volume No. 4: Performance Monitoring Methodology Report***
- ***Iraq-AWARE Volume No. 5: Research and Education Implementation Progress Reports***
- ***Iraq-AWARE Volume No. 6: Performance Monitoring and Financial Progress Reports*** (submitted monthly and quarterly)
- ***Iraq-AWARE Volume No. 7: Final Report***

5.2 Project Schedule and Milestones

The following chart presents a tentative schedule for the project, including the milestones for producing the project deliverables for submission to USAID.



Section 6
Selected References

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Ms. ROS-LEHTINEN. I look forward to asking you some questions about the Everglades model, how it can be used and not used. Thank you for pointing out how Saddam Hussein used these marshes in order to have political gain on his own population, and that is why I am so pleased to have Dr. Alwash here with us.

We know about the impact that the draining of the marshes has had on the environment, on the species, on animals, vegetation, fishing, but most especially on the population that has lived there

and the internal displacement of thousands and thousands of people; and we look forward to your testimony Dr. Alwash.

STATEMENT OF AZZAM ALWASH, SENIOR PROJECT ADVISOR, EDEN AGAIN

Mr. ALWASH. Thank you, Madam Chairwoman. Thank you for giving me the opportunity to address you.

Ms. ROS-LEHTINEN. Push that little button there.

Mr. ALWASH. Sorry. This is my first time addressing Congress.

Ms. ROS-LEHTINEN. You are doing great.

Mr. ALWASH. I was born in Iraq at the edge of the Mesopotamia Marshlands and became a citizen of the United States in 1990. During the 1990s, stories began to drift around about the draining of my marshlands, but we could not comprehend that such a vast area could be dry.

In 2001, the United Nations Environmental Program published satellite images demonstrating what they termed "a major environmental catastrophe that will be remembered as one of humanity's worst engineered disasters," the disappearance of Iraq's marshlands.

Why is this a catastrophe? Before 1990, the Mesopotamia Marshlands consisted of the largest wetland ecosystem in the Middle East, covering an area larger than the State of Massachusetts. Scholars consider these marshlands as the biblical Garden of Eden and as the birthplace of Abraham and the cradle of western civilization, the ancient Sumerian culture. In 1998, it was estimated there were a half million of marsh dwellers carrying on these ancient traditions within and around the marshlands.

Following the Gulf War in 1991, rebel forces used the marshlands as a safe haven within the southern no fly zone. In a few short years, Saddam's regime systematically drained them to establish control over the area. After they were dried, the marshlands were burned and villages were destroyed. During the 1990s, up to 300,000 marsh dwellers died, fled the country, or were internally displaced.

In 2001, the Iraq Foundation initiated Eden Again. We assembled a team of experts, our International Technical Advisory Panel, to begin planning for the day after Saddam. Many are on the National Research Council, and they provided us with excellent advice. In the summer of 2003, following the liberation of Iraq, I returned to Iraq to begin implementation of those plans in coordination with USAID.

Ladies and Gentlemen, in 2003, you saw troops move through blinding dust storms. They were rolling across the dried marshlands. None of the water you see in those photographs was there at the time. But almost immediately after liberation, the marsh dwellers began to breach the embankments that held back the precious water. They opened the sluice gates and heaven poured back in. Acting largely on their own local initiatives, five separate areas have been reflooded, nearly doubling the areas before liberation. Most areas remain dust bowls.

It is often said that environmental conservation is a luxury of a wealthy people. But the marsh dwellers are people who want to desperately restore their ecosystem, a habitat they are dependent

for their survival. They do not want to be busboys or living in city slums. They want to live in the clean fresh air of the marshland. They want to hunt, fish, raise water buffalo, vegetables and fruit, follow their own traditions. They cannot do that in the city or in the desert that the marshlands have become.

The U.S. has helped. The U.S. Agency For International Development has brought some renowned scientists to the area to help evaluate their condition. I just returned from their second expedition, and they are beginning a series of projects within the next year.

The Ministry of Water has declared that the restoration is the Ministry's highest priority and has established a center.

The good news from Iraq is that restoration is completely within the realm of possibility. The difficulty lies in creating a just and equitable plan. We want help, but we cannot plan Iraq's environment. Only Iraqis can.

The goal for the next year is the preparation of a sustainable restoration plan. To attain this goal, the Iraq Foundation's International Advisory Panel recommended that three activities take place concurrently: One, implement demonstration projects to observe how the ecosystem responds to rehydration; two, conduct a series of comprehensive environmental surveys, to be conducted by Iraqi scientists with the assistance of experts, to provide a scientific basis for making wise land-use decisions; and, three, to obtain input from stakeholders to allow for decision-making to provide for a participatory process within Iraq.

We estimate it will require $10 million for a sustainable restoration plan. Over the past year, the Italian Ministry of Environment and Territory has provided over 2 million Euros to the Iraq Foundation in support of marshland restoration, and Italian experts have given generously of their own time in the marshes. I have a letter from the Italian Ministry of the Environment stating they are eager to work with the Iraq Foundation and the United States for a sustainable restoration plan.

With the assistance of the Italian experts, USAID, the Army Corps of Engineers and others, we are confident that the plan will be developed that is equitable and effective. Once that plan is in place, Iraq can become eligible for significant funds for its implementation.

I would like to conclude by thanking the United States and the Coalition for the most important contribution of all, giving Iraqis freedom from tyranny and the liberty to make their own decisions. Despite what you hear in the press, have no doubt in your mind that the vast majority of Iraqis join me in expressing this deep gratitude.

Thank you.

Ms. ROS-LEHTINEN. Thank you for your testimony.

[The prepared statement of Mr. Alwash follows:]

PREPARED STATEMENT OF AZZAM ALWASH, SENIOR PROJECT ADVISOR, EDEN AGAIN

Chairwoman Ileana Ros-Lehtinen, honorable congressmen, thank you very much for giving me this opportunity to address you.

I was born in Iraq at the edge of the Mesopotamian Marshlands and became a citizen of the United States in 1990. During the 1990s, stories began to drift around about the draining of my marshlands, but we could not comprehend that such a vast

area could be dried. In 2001, the United Nations Environmental Program published satellite images demonstrating what they termed "a major environmental catastrophe that will be remembered as one of humanity's worst engineered disasters"—the disappearance of Iraq's marshlands.

Why is this a catastrophe? Before 1990, the Mesopotamian Marshlands constituted the largest wetland ecosystem in the Middle East, covering an area larger than the state of Massachusetts. Scholars consider these marshlands to represent the Biblical Garden of Eden, the birthplace of Abraham, and the cradle of western civilization, the ancient Sumerian culture. In 1988, it was estimated that there were half a million Marsh Dwellers carrying on these ancient traditions within the marshlands.

Following the Gulf War in 1991, rebel forces used the marshlands as a safe haven within the southern "no fly zone." In a few short years, Saddam's regime systematically drained them to allow access for his tanks and to establish control. After they were dried, the marshlands were burned and the villages destroyed. During the 1990s, up to 300,000 Marsh Dwellers died, fled the country, or were internally displaced.

In 2001, the Iraq Foundation initiated the Eden Again Project. We assembled a team of experts, our "International Technical Advisory Panel," to begin planning for restoration—for the day after Saddam's regime fell. Many of the scientists on this panel are on the National Research Council, and they provided us with excellent advice. In the summer of 2003, I returned to Iraq to implement those plans.

Ladies and gentlemen, in 2003 you saw Coalition troops moving through blinding dust storms; those tanks were rolling across the dried marshlands. None of the water that you see in these photographs was there at the time. But almost immediately after liberation, the Marsh Dwellers began to breach the embankments that held back the precious water. They opened the sluice gates and heaven poured back in. Acting largely on their own local initiatives, five separate areas have been reflooded, nearly doubling the area of wetlands that were left before liberation. But that's only a small fraction of the former marshlands, most of which remain dustbowls.

It is often said that environmental conservation is a luxury of a wealthy people. But the Marsh Dwellers are a desperately poor people who desperately want to restore their ecosystem, a habitat upon which they are dependent for survival. These people don't want to be busboys or factory workers living in city slums. They want to live in the clean fresh air of the marshes; they want to hunt and fish and raise water buffalo, vegetables and fruit. They want to practice their own culture, follow their own traditions. They can't do that in the city and they can't do that in the desert that the marshlands have become.

The U.S. has helped. The U.S. Agency for International Development has brought some renowned restoration scientists to the marshlands to help us evaluate their condition. I just returned from their second expedition, and I can report that USAID is planning a series of very beneficial projects within the next year.

The U.S. Army Corps of Engineers has provided extremely capable assistance to Iraq's Ministry of Water Resources. With their guidance, the Ministry has declared restoration of the marshes their number one priority, and has established a Center for Restoration of the Iraqi Marshlands, abbreviated "CRIM."

The good news from Iraq is that restoration is completely within the realm of possibility; the difficulty lies in creating a just and equitable plan. The international scientists can help with the technical work—and we want their help—but they can't plan Iraq's environment. Only Iraqis can.

CRIM's goal for the next year is preparation of a Sustainable Restoration Plan. To attain this goal, the Iraq Foundation's International Technical Advisory Panel recommended that three activities take place concurrently: 1) implement demonstration projects to observe how the ecosystem responds to re-hydration; 2) conduct a series of comprehensive environmental surveys, to be accomplished by Iraqi scientists with the assistance of international experts, to provide a scientific basis for making wise land-use decisions; and 3) obtain input from stakeholders to allow for decision-making through a participatory process within Iraq.

We estimate that CRIM will require $10 million to complete this process and prepare a Sustainable Restoration Plan. Over the last year, the Italian Ministry of the Environment and Territory has provided over two million Euros to the Iraq Foundation in support of marshland restoration, and Italian experts have given generously of their time in the marshes. I have a letter from the Italian Ministry of the Environment stating that they are eager to work with the Iraq Foundation and the United States to provide support for developing the Sustainable Restoration Plan. With the assistance of the Italian experts, USAID, UNEP, the Army Corps of Engineers, and others, we are confident that a plan will be developed that is equitable

and effective. Once the plan in place, Iraq can become eligible for more significant international funds for its implementation.

I would like to conclude by thanking the United States and the Coalition for the most important contribution of all: giving Iraqis freedom from tyranny and the liberty to make their own decisions. Despite what you hear in the press, have no doubt in your mind that the vast majority of Iraqis join me in expressing this deep gratitude. Thank you.

Ms. ROS-LEHTINEN. Doctor, if you could elaborate on the political reasons that Saddam Hussein had for draining the marshlands.

Mr. ALWASH. Madam Chairwoman, the marshlands, I like to refer to them as Iraq's Sherwood Forest. They have been a place where people who did not want to be under the control of the central government went to hide because you cannot find them. They are big wetlands, if you see them.

After the Gulf War, when Iraqi rebels went and controlled the south, following the crushing of that rebellion, a lot of the rebels went into the marshlands to hide, Iraq south being virtually ungovernable between '92 and '95. So what he tried to do was to deprive the rebels of a place to hide, where they could easily live off the land and to come out at night to challenge his authority over the towns.

It is obvious as to why he did that, but the declared reason by Iraq is that the drying was to reclaim agricultural land, as if Iraq was devoid of agricultural land.

You can drive and take pictures of Iraq. Iraq is full of areas that can be cultivated rather easily. One did not need to spend billions and billions of dollars to dry the marshlands to reclaim agricultural land.

Ms. ROS-LEHTINEN. Now, there were about 300,000 marsh——

Mr. ALWASH. Estimated between 300 to 500,000 people that have been displaced.

Ms. ROS-LEHTINEN. And some have been displaced, some to neighboring countries or internally displaced.

How much unity is there in this group? We are talking about such a large number of people. Would they come back, first of all, if the marshes were restored? Would they hope to become fishermen of that area, again?

What is their attitude, also, of this restoration effort? You say that they want to make sure that they are the ones who decide their future, but is there unity in this, such a large number of people, about how it should be restored?

Mr. ALWASH. Unity is difficult to achieve, but in the sample that I have from Nasiriyah area, the people that I met, 1-in-10 basically—they would like to maintain their marshlands—sorry, they would like to maintain their farmlands. The vast majority of the people who I interviewed want their marshes back.

Obviously, other areas differ. It depends on how you put the question to them, too: Would you like to go back to your way of life?

Well, their way of life was, you know, idyllic. It is beautiful, it is nice, we see in pictures, but it is rather harsh. So do they want to go back to their old way of living?

They have seen the Internet. They want electricity. They want also what we term modern needs. They do need that. But if you put the question to them in the proper form: Do you want your marshes returned while providing health services, education, pota-

ble water, all the things we take for granted—to date, they still do not have it. Obviously, if I put the question to them that way, they will answer in the positive.

If you ask, do you want your marshlands or farms, the answer will be different. So I would leave it up to the people themselves. The way I deal with it is through the tribal leaders and the tribal elders. That is the way to reach consensus within the community.

Ms. ROS-LEHTINEN. And although this project is now going, taking place, we really don't have much of a track record about restoring this marshland. How satisfied are you that the efforts so far have included Iraqi cooperation, that the Iraqi voices are being heard, listened to by USAID and all of the different agencies that are involved in the restoration efforts?

Mr. ALWASH. Iraq Foundation is a part of USAID's efforts, so to that extent, you know, they are including Iraqis in the decision. I would like to see a little bit more Iraqi NGOs' participation. I would like to see, you know, what we predicted back last March, is that the Iraqis are not going to wait for us to come up with this plan. They are in fact going to vote with their own hands, and they did: The beach embankments, and the beach real estate—and they have returned water to many areas, in fact, in some places in a haphazard way. So to that extent, you know, we are kind of—we need to act faster, Chairwoman. We can't be waiting since last March till now. We should have developed the plan by now, in my opinion.

Ms. ROS-LEHTINEN. How optimistic are you that if the funding is there, and if Iraqi voices are listened to, and if the interagency cooperation is there and the countries cooperate, that these marshes can be restored; or is it too late for certain areas?

Mr. ALWASH. You can see the pictures. Mother Nature is quite wonderful. A lot of areas, all it took was return the water, and nature started restoring herself. As you heard from USAID, the challenge is in sustainable restoration: How do you make sure that there is enough water in the long term to sustain the areas that have been restored?

I keep on saying that the plan, overall restoration plan, should have three major phases:

One is the initial phase, and restore whatever can be restored given the available water resources today.

The medium term is widen the area of restoration by achieving efficiencies of stream. Iraq is still using the old Sumerian technology of irrigating the land. There are over 50 percent losses in delivery of water, an even 50 percent, and even more than that through inefficient irrigation methods. A lot more water can be made available only for restoration through achieving the efficiencies of stream. That is what I would term as the midterm.

Now the long term, obviously, is a political realm. Obviously it is going to require achieving some sort of political decision between Turkey, Syria, Iraq, and Iran about the equitable sharing of the water resources of the basin of the Tigris and the Euphrates. That can be achieved, though it must be done in a wise way. We cannot get into a situation sort of like the Israeli-Palestinian problem. These are my people and I know Iraqis very well. If the discussion ever becomes a question of whose water is this, we are not going

to get a solution. Fifty years from now we are still talking about whose water this is. We need to find a solution and in the realm of free market economy.

And what I advocate is for Iraq to not buy water from Turkey, but rather buy electricity. I live in Baghdad. I live in Basra. And for every 2 hours of electricity, we are rewarded with 4 hours without electricity. We definitely need a lot of electricity, and Iraq is bankrupt. Iraq cannot buy all the generation equipment that is needed to generate electrical current that is needed for Iraq's current situation, even in the future as the economy develops. So if, in fact, we purchase electricity from Turkey, Turkey may need to generate or release a lot of the water that they are holding.

You know, I am told that that plan is in fact within the realm. You know, it can be discussed; but it is obviously beyond what the Iraq Foundation can do. It is something that is up to the future Iraqi Government, the Government of Turkey, Government of Syria, and Government of Iran to discuss. But I have positive feelings about the future. Whatever we can restore today will be maintained. And don't forget, Iraqis of the south have learned now that it is their right to speak. They can speak out for themselves. And these areas that are restored are going to be very difficult to drive back. They are going to demand their fair share of the water. And I am optimistic, very optimistic.

Ms. ROS-LEHTINEN. Wonderful. It is good to hear. Well, as Mark Twain said, water flows upstream toward money. So that is at the root of it. But thank you for your testimony.

And, Dr. Miralles, I had asked Dr. Alwash that question about whether it is possible to turn back the hands of time, because I am honored to represent the entire coastline of southern Florida, from Bal Harbor, North Miami Beach, all the way down to Key West. And as you know, we have some precious coral reefs especially in the Keys, and many scientists, wonderful scientists at the the Rosenstiel School, for example, have said that there are areas there that cannot be restored. They will never—we don't have enough money to restore the damage that has been done to our coral reef.

When you compare the ecosystem of the Iraqi marshlands, how optimistic are you that with enough resources and enough cooperation they can be restored?

Mr. MIRALLES-WILHELM. Well, I think I am optimistic as well. It is just a matter of defining where is it that you want to go with the restoration of the Iraqi marshlands, as was the question that was posed on the Everglades many years back. You know, we probably can't turn around time and restore it back to where it was, but we can probably restore it to something that is still going to be very valuable.

And in the context of sustainable development, we have many things going on in the case of south Florida. You have development, you have agriculture, you have highly urbanized region population growth that needs water. These things need to be considered together. It is really difficult to say we are going to return the Everglades to what they were 100 years ago or 1,000 years ago. I would suggest the same thing with the Iraqi marshlands.

So it is a matter of defining where is it that you want to take the Iraqi marshlands. Certainly it is going to be a better place than

where they are today, but it is probably not going to be the same place where they were before this all happened.

Ms. ROS-LEHTINEN. When you mentioned the Everglades in your testimony and your answer now, how does that compare? How can we use the Everglades restoration as a model? What are the similarities, the differences, and how does it fit or not fit in terms of restoration of the marshlands?

Mr. MIRALLES-WILHELM. You know, in strictly science terms, in terms of both ecosystems, there are a lot of similarities. I think, though, that the lessons learned in the Everglades were not so much on the signs but on actually the process of bringing about the restoration. How is it that we can take some ideas of restoration, building consensus for it, getting the funds to do it, and actually start executing it? That is a long learning process and involves not only scientists like myself, but also involves water management agencies, industrial representatives, and a whole host of stakeholders. I think that our colleagues in Iraq may benefit from using the Everglades as an example of that process.

I did mention specifically how the Everglades has been used in south Florida to essentially—it is the cornerstone, the centerpiece of development. When I think of Basra and southern Iraq, I keep calling Basra the Miami of Iraq, and it is essentially a very similar situation. I can see Basra turning into a Miami with all the positives and the not-so-positives.

Ms. ROS-LEHTINEN. I know that this is a USAID map and some of the photos and layout of the marshlands, but can any of you explain what we are looking at, and what Iraq—where your project would be, or some of the restoration efforts that are underway?

Mr. MIRALLES-WILHELM. Well, I will do part of the explanation. I am sure Dr. Alwash will be happy to add something. It is essentially a concurrent set of satellite pictures. If you look at the—probably the easiest ones to read are the ones, the row below. The purplish indicates regions where there were marshes, vegetative marshes with water. That shows essentially a time line degradation of the marsh over time. You can see that the purple has significantly been reduced. My guess is that the right corner picture is probably a 2000, 2001 picture. That was going to be my guess.

Essentially the idea is we can't really turn the clock back and go back to the first picture, but there are many opportunities within existing resources to turn around the situation into a place where people can live and breathe. It is not going to be the Eden again, but it might be a place where southern Iraqis can live and build, and live with their families and have a healthy ecosystem, free of disease, environmentally benign, and all these things.

Ms. ROS-LEHTINEN. Dr. Alwash.

Mr. ALWASH. Yeah. These pictures are——

Ms. ROS-LEHTINEN. Push that little button.

Mr. ALWASH. The pictures are essentially what Dr. Fernando has—Dr. Miralles has described. The latest satellite picture from the marshlands as of a week ago, from NASA site shows the area above the Euphrates. It is kind of difficult here to do this without a laser pointer.

Ms. ROS-LEHTINEN. I have one here so I can know what you are talking about.

Mr. ALWASH. It shows a good proportion of the Hammar marshes. The Hammar marshes are the marshes below the Euphrates. They are the southerly-most marshes. Those satellite pictures show that the majority of those marshes are in fact covered with water now, and a good proportion of the central marshes, about 30 kilometers to 40 kilometers north of the Euphrates, is now inundated with water.

I can tell you that over 1,000 people have come back to the marshes and they are fishing. The marshes are full of fishermen. They are, in fact, overstressing the system by using some fishing technology that would not be legal in the United States. But these are poor people, these are hungry people, and when I asked, you know, this is really forbidden, you shouldn't be doing this, they said, No, it is halal. What else do you want us to feed our children?

These people are not stressing the system, the ecosystem, because they are bad people; they just want to feed their children.

Ms. ROS-LEHTINEN. They want to survive.

Mr. ALWASH. They just want to survive. And what our job should be is to help them survive by increasing the area where they can ply their ancient trade by providing health services, by providing potable water. Things of that nature will make their life.

And you know, let me add that it is in the United States' national security interest to do this. The people of the south are for now very happy to be liberated, but if their economic situation does not improve they may turn against us. We need to help them achieve a better state of living. We need—they are now grateful and I can assure you—I mean, wherever I go, Bush, Bush, good, okay.

So the point I am trying to make is the United States should be committed to this project, specifically to maintain this gratitude, to build upon it, and to help create an Iraq that is friendly to the United States.

Ms. ROS-LEHTINEN. I agree. It is so difficult with a country that has been under such brutal dictatorship for decades, to build and educate a population on how the environment, and the protection of the environment is important to their daily lives. And I think that making the connection to economic livelihood is the most important thing that we can do, so that people know why it is in their best interest to ensure that the environmental beauty of this area continues; that it is for their own livelihood that is at stake.

How is it that you plan, Dr. Miralles, with the Iraq-AWARE, project to build that level of cooperation with the population of this area and how much input will they have into your project Iraq-AWARE? How much interplay will you have with the university that you mentioned, as well as the population, so that they know what you are doing and they have a stake in it as well?

Mr. MIRALLES-WILHELM. Yes. I mean we are at the very initial stages. Essentially what we try—the first stage is essentially to link peers in both countries, United States and Iraq, working on similar research and on educational activities. So that there is already a collaboration of sorts going on. And, you know, we have a series of activities that have been planned that have been started with full participation of Iraqi colleagues at the University of Basra and with our colleagues at the University of Miami. I think that

is going to be a very good first stage, because I think rebuilding or helping rebuild the Iraqi universities will eventually translate, will eventually move downstream to the population of the southern Iraqi area.

I mean, I keep seeing a vision of getting more and more students from Basra involved in these activities. And these activities range from scientific research activities to joint education as courses on wetlands restoration capacity building. I think we are at the very initial stage. We have done this with a stringent, limited, in-house funding, and we really need to move to the next level to actually continue moving along this level. And it is really imperative, and I will echo what our colleagues of USAID said. It is really about getting—the limiting step now is funding.

Ms. ROS-LEHTINEN. It is just incredible that this is an area that is so historical. It is a population that can be traced back thousands of years, and who have lived in this area and sustained themselves just by fishing and the wildlife and their environment right around them. And now, to see what the destruction of—in just a few decades, what a man has done in an area that was so beautiful and so lively for thousands of years.

Why is it in our interest to make sure that these marshlands are restored? What can we say to our constituents who are paying taxes to let them know why it is needed for U.S. interests to build these marshlands to what they were, or restore them as much as we could? Can both of you make that statement to my constituents, why they should pay taxes for such an effort?

Mr. MIRALLES-WILHELM. Well, I am going to echo what Dr. Alwash mentioned earlier. I think it is really about building political—continued political stability in the region. I think the Iraqi people are very grateful now, and I will echo again what Dr. Alwash said. All the people that I have talked to in Iraq, the Iraqis, they are very grateful that this has happened. But it won't be long before, if things don't start happening, there is going to be political instability in the region or there may be generated social unrest that may be carried out against the United States' interests in the region as a whole. So in terms of that, I think it is a matter of national security to some extent, more even than an environmental problem.

Ms. ROS-LEHTINEN. Dr. Alwash.

Mr. ALWASH. You know, that is the main reason for the United States to help this. But let me also bring back the parallels with the Everglades.

Number one, the restoration of the Iraqi marshes I don't think is going to be the responsibility of the United States to sponsor. But I just want to allay your fears. This is not going to be a $9 billion project. For one, we are not going to hire lawyers. For two, we don't have to buy real estate. And even if we have to buy real estate, the real estate is very, very cheap in Iraq.

Ms. ROS-LEHTINEN. The comparison to Miami made me a little nervous.

Mr. ALWASH. Once we have the plan, Madam Chairwoman, I think that there are many many countries that would be willing to sponsor the construction projects that are associated with the re-

stored managed wetlands. And we are not going to return the wetlands to the way it was. There are going to be managed wetlands.

But I can say that I have been in discussions with many, including the Japanese, including Kuwait. We understand that there is a lot of interest to actually put the plan in action and construct. Canada is also very much interested. I went to Canada to discuss it. So first of all, the cost is not going to be this humongous $9 billion cost. And, more importantly, it is for the benefit of the region itself to have the restoration be sponsored by them.

For example, I mean the restoration of the marshes will act to cleanse these waters that, as Mr. West suggested, all the sewage is being dumped raw in the waters of the Euphrates and the Tigris in Iraq. Previously the marshlands acted as a kind of a liver for these waters before they delivered to the marshlands. And, in fact, restoring the marshlands may act as a way of helping the environment of the Gulf, thereby helping the Gulf countries.

So there is a positive direction or a positive impact on the Gulf by the restoration. Therefore, they should be one of the countries or one of the regions that we should target for sponsoring the actual construction and the actual implementation of the plan that the CRIM should come up with. I should also say that I have detailed proposal for the CRIM to detail this $10 million, 5 million of which—a portion of it—is in fact going to be supported by the Italian Minister of the Environment. What we are looking for is——

Ms. ROS-LEHTINEN. And they are not going to hire any lawyers either, are they?

Mr. ALWASH. I certainly hope not.

Ms. ROS-LEHTINEN. Well, thank you so much, gentlemen. We definitely agree with you that this restoration of the Iraqi marshlands is important in terms of national security, in terms of being a model for the entire region about what other countries can do. And it certainly highlights the problem of Saddam Hussein and how one madman had destroyed an area that had been a vibrant wetland for over 5,000 years and provided a livelihood for 300,000 people and what displacement of the refugees has created.

So, thank you so much. I hope that Congress steps up to the plate, I hope that we are able to get funding for this project, and I thank you both for your wonderful testimony.

And Dr. Alwash, you did a great job. I think it is the cape. Please explain that beautiful cape you have.

Mr. ALWASH. Oh, that is what a marsh—well not every marsh Arab. This is a tribal sheikh robe, and the golden embroidery is typical of Chibayish area of the Hammar marsh area. This is one of the very first things that I purchased.

Ms. ROS-LEHTINEN. It is beautiful. Analogous to the Everglades, the Miccosukee Indians have their own jackets as well. So we have a similar model.

But thank you so much and I thank the audience for participating as well. And the Subcommittee is now adjourned. Thank you, gentlemen.

[Whereupon, at 11:22 a.m., the Subcommittee was adjourned.]

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